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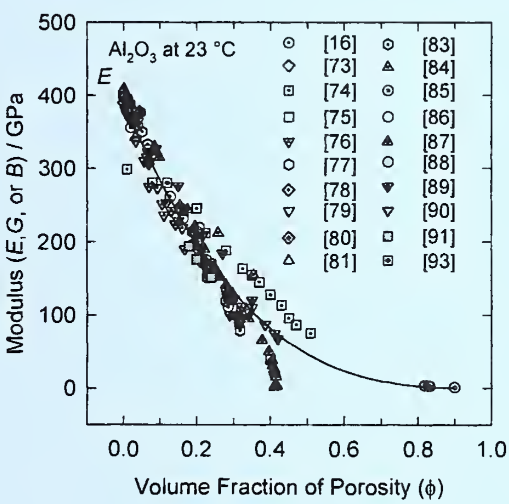
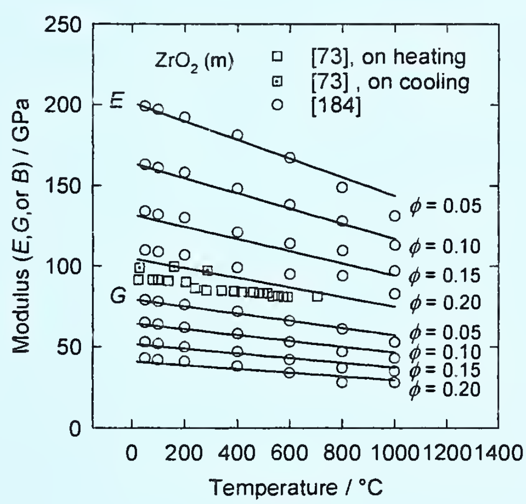
R. G. Munro
Ceramics Division
Materials Science and Engineering Laboratory





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R. G. Munro
Ceramics Division, National Institute of Standards and Technology
Gaithersburg, Maryland 20899

ABSTRACT

A compilation of elastic moduli data, including Young's modulus, shear modulus, bulk modulus, and Poisson's ratio, is presented for polycrystalline oxide ceramics. The data have been collected from the technical literature, either as reported in textual or tabular formats or as digitized from graphical formats. Special emphasis is placed on the dependence of the moduli on porosity and temperature. For each material having sufficient data, an analytical model describing the simultaneous porosity and temperature dependence is fit to the data to provide a succinct and useful representation of the combined data.

Key Words

bulk modulus, elastic modulus, oxide ceramics, Poisson's ratio, porosity dependence, shear modulus, temperature dependence

Table of Contents

1. Introduction

All solid materials can deform, stretch, compress, bend, flex, shear, twist, or otherwise deviate from their original unstressed sizes and shapes when subjected to external forces or internal thermal stresses. This propensity of materials to deform under exerted forces is a critically important consideration in the design of any mechanical component whose operation depends on its ability to sustain loads or to maintain dimensions within specified tolerances. Especially important is the condition known as elastic deformation.

The deformation produced by an external force acting on a solid is said to be elastic when removing the external force returns the solid to its original undeformed state. [1]

Quantitative results describing the relationship between the magnitude of the applied force and the amount of deformation were presented as early as the 1660s by the English scientist, philosopher, inventor, Robert Hooke [2]. For linearly elastic materials, the idealized relation bearing his name may be written as

$$\sigma = E\epsilon \qquad \textbf{(1)}$$

in which σ is the applied stress (force per unit area), ϵ is the strain (fractional elongation), and E is a proportionality constant known variously as the elastic modulus, Young's modulus [3], the coefficient of elasticity, the tensile modulus, and diverse other names. A similar relation can be found for the case of a shear stress, τ, that produces an angular deformation, γ.

$$\tau = G\gamma \qquad \textbf{(2)}$$

The coefficient, G, is known variously as the shear modulus, Coulomb's modulus [4], the torsion modulus, and the rigidity modulus. For isotropic polycrystalline materials, the two parameters, E and G, are sufficient to describe the macroscopic elastic behavior completely. However, it is convenient to consider two alternate parameters, Poisson's ratio and the bulk modulus, that describe specific attributes of the elastic behavior of isotropic materials.

Poisson's ratio, ν, describes the relation between axial and lateral strains. For example, when a rod of uniform circular cross section is elongated by a tensile stress along the rod axis, the cross section undergoes a decrease in diameter. The negative of the ratio of the lateral and axial strains is Poisson's ratio,

$$\nu = -\frac{\epsilon_{lateral}}{\epsilon_{axial}}. \qquad \textbf{(3)}$$

For isotropic materials, it can be shown that

$$\nu = \frac{E}{2G} - 1. \qquad \textbf{(4)}$$

The bulk modulus, B, describes the particular circumstance when stress is applied hydrostatically rather than uniaxially. The hydrostatic pressure, P, applied to an isotropic solid, causes the volume, V, to decrease such that,

$$B = -V\left(\frac{\partial P}{\partial V}\right)_T \qquad \textbf{(5)}$$

where the subscript T denotes constant temperature. Taking into account Poisson's ratio, the strain in the x-direction, ϵ_x, in a three dimensional material with Cartesian coordinates (x, y, z), is given by the appropriate generalization of Eq. (1),

$$\epsilon_x = \frac{1}{E}\left[\sigma_x - \nu(\sigma_y + \sigma_z)\right] \qquad \textbf{(6)}$$

where, with respect to the x direction, σ_x is the axial stress and σ_y and σ_z are laterial stresses. Similar expressions apply to ϵ_y and ϵ_z with obvious permutations of indices in Eq. (6). Under hydrostatic conditions, the volumetric strain is simply $\delta V/V = \epsilon_x + \epsilon_y + \epsilon_z$, to first order in the linear strains, and the stresses are $\sigma_x = \sigma_y = \sigma_z = -P$. Consequently, from Eq. (5) and Eq. (6),

$$B = \frac{E}{3(1-2\nu)} \qquad \textbf{(7)}$$

for isotropic materials. Using Eq. (4) in Eq. (7), B can be expressed alternatively in terms of E and G.

$$B = \frac{EG}{9G - 3E}. \qquad \textbf{(8)}$$

As a matter of practice, most of the data found in this compilation are from reported determinations of E and G. The parameters ν and B are most commonly calculated using Eq. (4) and Eq. (8), respectively.

2. Measurement methods and standards

Measurement techniques commonly used to determine elastic moduli may be classified into two generic types, static (isothermal) and dynamic (adiabatic), and the terms 'static moduli' and 'dynamic moduli' are sometimes used to distinguish results from the two types of measurements. Adiabatic elastic moduli theoretically are greater than isothermal moduli, but the difference, about 0.3 %, is negligible for the present data. The static type involves stress/strain measurements employing Eqs. (1) and (2) directly, while the dynamic type consists of resonance techniques or sound velocity measurements. Resonance methods require the detection of a resonant frequency, while the sound velocity techniques determine the time of flight of a sound wave over a known distance.

Table I: ASTM standards for E and G

Standard	*Scope*
E 111	stress/strain slope; metals
C 215	sonic resonance; concrete
C 469	longitudinal compression; concrete
C 674	static deflection in three-point bend; whitewares
C 623	sonic resonance; glass and glass ceramics
C 769	sonic velocity; carbon and graphite
C 747	sonic resonance; carbon and graphite
C 848	sonic resonance; whitewares
C 885	sonic resonance; refractories
C 1198	sonic resonance; advanced ceramics
C 1259	sonic resonance, impulse excitation; advanced ceramics
E 1875	sonic resonance; elastic materials
E 1876	sonic resonance, impulse excitation; elastic materials

Numerous ASTM standards, Table I, have been developed for measurements of *E* and *G* [5]. Standard E 111, which uses the initial linear slope of the directly measured stress *vs*. strain curve, is intended primarily for metals. A static modulus is also obtained by Standard C 469, which is intended for concrete under longitudinal compression, and by Standard C 674, which is intended for ceramic whitewares and utilizes a three-point bend test to measure the deflection of bars or rods under loading. Standard C 769 uses sonic velocity measurements applied to carbon and graphite.

The remaining standards pertain to dynamic moduli determined by resonating a rod or bar at its resonant frequency. The initial basis for this approach seems to have been provided by a series of papers by Timoshenko [1,193] which related the elastic properties to the resonant frequency, mass, and physical dimensions of the bar. This work was followed by a series of studies to refine the experimental technique and to refine the semiempirical equations relating *E* to frequency and bar dimensions. Goens [194] and Forster [195] pioneered work in Germany. Pickett [6] in the USA refined the equations further in 1945. The application of these methods was then advanced to their present utility by S. Spinner and W. E. Tefft at the National Bureau of Standards [7]. ASTM standard C 623 relies heavily on their 1961 paper, while standards C 747, C 848, C 885, C 1198, and E 1875 adapt and extend standard C 623. Standards C 1259 and E 1876 address the most recent innovation known as the impulse excitation method [8] and add the resonance of disk specimens as an option.

In addition to the ASTM standards, it is noteworthy that the development of international standards for the measurement of elastic moduli are currently in progress. At the present time, the International Organization for Standardization is voting on standard ISO 17561, Fine Ceramics (Advanced Ceramics, Advanced Technical Ceramics)--Test Method for Elastic Moduli of Monolithic Ceramics at Room Temperature by Sonic Resonance. ISO 17561 is very similar to ASTM C 1198.

Studies, principally on metals, have been conducted to compare and assess the various methods [9-11]. In early studies [9], the average results from both static and dynamic methods were found to be reasonably consistent with the variance among laboratories being more significant than the variance for a single laboratory's results. In later studies, however, measurement uncertainties were found to be significantly larger for static methods than for dynamic methods. In one study [12], the standard deviation of the static test results was approximately 7 % of the mean, while for the dynamic methods, the relative standard deviation was only 1.5 %. Those results were consistent with an earlier round robin study of dynamic test methods [13] in which the standard deviation was found to be 2 % of the mean. Interestingly, the latter study identified measurement of the bulk density as being a significant factor contributing to the interlaboratory variance of the dynamic measurement results. When the moduli were reevaluated using the common mean density, the relative standard deviation of the moduli was reduced to 1.6 %. This level of uncertainty is consistent also with the analysis in the Precision and Bias section of ASTM C 1259. That study estimated a relative uncertainty of 1.7 % when the component measurement errors for frequency, mass, and dimensions were 0.1 %. However, it should be noted that this uncertainty is much larger than the relative uncertainty pertaining to the precision of a single instrument, which can be as much as an order of magnitude smaller (0.2 % for a dynamic resonance technique [14] applied to an alumina reference material).

With respect to the present compilation, we may take the round robin result (an uncertainty of 2 %) as a lower limit of the uncertainty to be anticipated for results derived from independent studies, for which materials are only nominally similar.

Measurements of elastic properties at elevated temperatures are most commonly performed using the dynamic methods. ASTM standard C 623 and its derivative standards provide for the use of either a cryogenic cabinet (for measurements at low temperature, down to -195 °C) or a furnace (for measurements at high temperature, up to 1200 °C). Static methods are used infrequently for the high temperature measurements and are considered to be less reliable, particularly when creep occurs.

An additional factor of considerable importance to the reliability of elastic moduli data is the determination of the volume fraction of porosity present in the material [15]. Unfortunately, the role of porosity is often treated rather superficially in the literature. It is extremely rare that studies of elastic moduli are accompanied by detailed analyses of pore shape and pore size distributions, and little effort seems to have been made towards distinguishing open, closed, and total porosity values, except in computer simulation studies. In the experimental works, the status of the material densification is most commonly (but not always!) represented by a value for the bulk density, ρ. From the known or nominal chemical composition of the material, it may be possible to calculate the maximum density, ρ_{theo}, for a theoretically nonporous single crystal of the material. In that case, the total volume fraction of porosity, ϕ, in the experimental specimen can be estimated from the simple relation,

$$\phi = 1 - \frac{\rho}{\rho_{theo}}. \qquad \textbf{(9)}$$

Of course, the presence of secondary glassy phases, additives, or impurities can modify this relation. In the present compilation, compounds are considered in relatively pure forms, except where noted explicitly, and porosity is always expressed in the context of Eq. (9).

3. Previous data reviews

Development of the class of materials now broadly known as advanced ceramics (*a.k.a.*, fine ceramics and engineering ceramics) began only as recently as the middle of the twentieth century. The first substantial review of the elastic properties of these materials appears to have been the very fine work of S. M. Lang in 1960 [16]. That paper presented the bulk density and dynamic moduli at room temperature, determined for 20 different materials consisting of oxides, carbides, borides, cermets, and intermetallic compounds. Over approximately the following three decades, O. L. Anderson *et al.* produced a series of papers [17-19] regarding the elastic properties of polycrystalline ceramics and minerals of importance to geophysics. More recently, R. W. Rice has undertaken a series of reviews of the physical properties of ceramics [15, 20-22] with the particular interest of gaining insight into the manner in which physical properties are influenced by porosity. Beginning in the late 1980s, the discovery of high temperature superconductivity led to a whole new class of advanced ceramics for which property data began to appear rapidly. Early reports of the elastic properties of these materials were reviewed by R. G. Munro [23] as part of a general review of the mechanical properties of high temperature superconductors, which were principally oxide ceramics.

4. Models

Compilations of property data serve two different purposes. For scientific studies, they serve as relatively generic collections of data providing the basis for statistical and theoretical analyses of general property relations. For engineering applications, they serve as materials property databases providing specific values to be used in product design and manufacturing. In the latter applications, computer aided design and manufacturing techniques enable simulations of a product's behavior under varying conditions of stress and temperature, in both equilibrium and nonequilibrium conditions. For such purposes, it is desirable to have a means of estimating the value of a property at an arbitrary point in the allowed range of the operating conditions. While interpolation techniques can be used with tabulated data, such approaches are relatively slow and cumbersome and require extensive tables of data for every material condition of interest to the application. A more succinct and efficient approach is to use semiempirical analytical models that incorporate both material and environmental factors within the model. In this section, we consider one such model for the elastic moduli data.

4.1 Dependent and independent variables

It has been discussed previously [24] that material properties, such as fracture toughness or elastic moduli, usually are not themselves independent variables describing a material system. Rather, the values of the properties derive from the interactions among the constituents of the material. The property values, therefore, are affected by such variables as the composition, the binding strengths, and the microstructure. In this regard, physical characteristics such as grain size, pore size, and the shapes of the grains and pores determine boundary conditions that serve as constraints on the interacting constituents. Mathematically, the values attained by the properties for a given material system are the particular solutions to the system of equations describing the interactions. Clearly, those values may be affected strongly by the constraints on the interactions and particularly by the boundary conditions.

Numerous studies have concluded that the elastic moduli of ceramics may depend strongly on the phase composition of the material specimen, the presence of pores, and the temperature, but do not exhibit any significant dependence on grain size. In the present work, any reference to a material will be taken implicitly to mean a collection of specimens having, at least, nominally similar phase compositions. The dependence of the elastic moduli on temperature and porosity will be treated explicitly.

Towards the end of finding a simple, analytic representation of the elastic moduli, we shall proceed heuristically, beginning with the assumption that a separation of variables may be applied to the dependence of elastic moduli on temperature and porosity. For any modulus, $M(T,\phi)$, of a given composition, it is assumed that we may consider

$$M(T,\phi) = M_T(T)\, M_\phi(\phi) \qquad \textbf{(10)}$$

such that our task is to find suitable representations for $M_T(T)$ and $M_\phi(\phi)$.

4.2 Temperature dependence

Empirically, the temperature dependence of Young's elastic modulus for most ceramics is relatively simple, generally decreasing monotonically with increasing temperature. At very low temperature, the slope of the modulus with respect to temperature must approach zero. On the basis of lattice dynamics, Born and Huang [25] estimated that the elastic constants should vary as T^4 at low temperature. Above room temperature, the moduli generally decrease linearly with increasing temperature. To describe the behavior from low to high temperature, Wachtman *et al.* [26] suggested the empirical relation

$$E_W(T) = E_0 - bT\exp(-T_0/T) \qquad \textbf{(11)}$$

in which E_0 is Young's modulus at absolute zero, and b and T_0 are parameters to be determined numerically from the observed data. Anderson [27] later provided a justification of an expression of this form for the bulk modulus and noted that the elastic modulus would be approximately of the same form if the temperature dependence of Poisson's ratio could be ignored.

Empirically, graphs of elastic moduli data *vs.* temperature exhibit very little curvature except at very low temperature. This lack of curvature causes numerical fitting routines to be rather insensitive to the exponential factor in Eq. (11). Consequently, the uncertainty in the value of the parameter, T_0, is unacceptably large for most of the data in the present compilation. For the present purpose, therefore, it suffices to consider only the simplified linear model

$$M_T(T) = M_T(0)\left(1 - a_M T\right) \qquad \textbf{(12)}$$

with the parameters rewritten as $M_T(0)$ and a_M for each modulus M.

4.3 Porosity dependence

The porosity dependence of the elastic properties of solids has been the subject of extensive investigation for decades. Numerous studies have examined the role of pores as the second component of two-phase solid media [28-33]. Those works generally involve an analysis of the strain field in the composite body under the application of an external stress. Alternatively, several studies [22,34-39] have observed that stress internally is transmitted only over the areas of contact between the constituent particles or grains. As the body is densified, the contact area increases while the porosity decreases. Consequently, the porosity dependence of the elastic moduli should be governed by the contact area. More recently, detailed analyses of the effects of pore size and pore shape have begun to be performed in finite element computer simulation calculations [40,41].

In addition to these microstructural modeling efforts, many semiempirical analytical models have been proposed to represent the general trend of elastic moduli with porosity. Analytical models are of considerable interest because of their potential use as smoothing and interpolation functions. Since these models only relate bulk elastic properties to the mean porosity, they generally do not represent detailed microstructural effects arising from varying pore shape, anisotropy, or nonuniformity. Their importance rests in their capacity to provide highly effective descriptions of the trends of the mean properties and characteristics of porous media. An approximate chronology of the principal models [42-51] that have been proposed for the elastic or Young's modulus is given in Table II, while numerous other studies[52-59] have explored their applicability to various experimental results.

Empirically, a simple linear model [42] may be adequate at very small porosity, but for most brittle materials, the elastic moduli vary approximately exponentially [44] for porosity up to about 30 %. At higher porosity, the elastic moduli may deviate significantly from an exponential dependence [21]. Several models treat porous media as a special case of a two-phase medium in which the second phase consists of pores [58]. Those models often express the moduli of porous materials as ratios, $P_1(\phi)/P_2(\phi)$, of polynomials (P_1 and P_2) in the volume fraction of porosity (ϕ). Budiansky's selfconsistent model [52] is of this type and results in a pair of coupled equations for the bulk and shear moduli. Those relations are explicitly linear in porosity and implicitly nonlinear through the selfconsistent dependence on Poisson's ratio, ν, which is itself dependent on porosity.

At very high porosity, other issues must be considered in determining the influence of porosity on elastic moduli. It is essentially selfevident that the volume fraction of porosity of a solid material must be less than one ($\phi < 1$) because the condition $\phi = 1$ corresponds to no material at all. As the limit $\phi = 1$ is approached, the contiguity of the assembage of components becomes an important issue since the integrity of an elastic medium is dependent on the transitivity of forces between adjacent material components. Indeed, in studies applying percolation theory, analyses of

Table II: Approximate chronology of empirical models for the porosity dependence of Young's elastic modulus

$E = E_o\,(1 - a\phi)$ [42]
$E = E_o\,(1 - a\phi + b\phi^2)$ [43]
$E = E_o\,exp(-a\phi)$ [44]
$E = E_o\,(1 - \phi)/(1 + a\phi)$ [45]
$E = E_o\,(1 - a\phi^{2\,3})$ [46]
$E = E_o\,exp(-a\phi + b\phi^2)$ [47]
$E = E_o\,(1 - \phi/\phi_c)^a$ [48]
$E = E_o\,(1 - \phi)^n$ [49]
$E = E_o\,(1 + a\phi + b\phi^2)/(1+c\phi)$ [50]
$E = E_o\,(1 - \phi^{2\,3})^a$ [51]

minimum solid areas of idealized stackings, and other models focused on the stacking of geometric shapes, there arises the possibility of a critical porosity, ϕ_c, at which the moduli must vanish [22]. Such studies pertain to the very important issue of the validity of interpreting such an assembly of material components as an elastic continuum. Phani and Niyogi [48] suggested that if we are to allow for a vanishing modulus, then Young's modulus, E, should be proportional to a power of $(1-\phi/\phi_c)$.

In the present work, elasticity, as a bulk concept, is taken to mean *a priori* that the spatial connectivity is sufficient to allow the bulk material to sustain an applied stress. For any such material, without exception, the elastic modulus does not vanish.

Assuming material contiguity, Wagh *et al.* [49] considered a model in which the material was assumed to be composed of a network of material chains and interposed with channels of open pores. For a one dimensional system, they obtained the closed form expression

$$E = E_o(1 - \phi)^n \qquad \textbf{(13)}$$

where E is Young's modulus, and E_o and n are constants. They then used numerical solutions to verify that the same expression should be valid also for a three dimensional system. That conclusion was consistent with the results of Gibson and Ashby [59] who obtained Eq. (13) for the specific case of cellular ceramics, with $n = 2$ for open cell structures and $n = 3$ for closed cells.

Among these various models, it may be noted that the suitability of the various analytical forms is not sharply distinguished over the observed range of porosity for polycrystalline ceramics. No one model seems to have a stronger theoretical justification than the others, and the empirical fits to the data are not sharply different. Additionally, the general trends of the elastic moduli data *vs.* porosity, for polycrystalline ceramics, do not seem to depend greatly on the nature of the porosity since results for specimens from multiple sources conform to a single trend line. Motivated by such observations, Munro [60] derived a simple effective medium theory for the porosity dependence of bulk moduli. In that work, the classical model of an ionic solid [17] was taken as an idealized, pore free, reference system. That choice had the particular virtue of providing a closed form expression for the bulk modulus. It was noted that the introduction of porosity into such a system must increase the molar volume of the material, M/ρ, where M is the molecular mass and ρ is the bulk density. As a result, the mean interaction potential at a site must be reduced because the mean interparticle distance is increased. To account for this relaxation in the model system, the length scale was formally renormalized. The renormalized system was then related to the porous physical system by imposing the consistency condition that the equilibrium volume of the renormalized system be equal to the sum of the volume at zero porosity and the pore volume. The result was the closed form expression

$$B = B_o(1-\phi)^m \; . \qquad \textbf{(14)}$$

In this model, the exponent, m, was determined by the effective attractive component of the interaction potential and can be different from the exponent, n, found in the similar expression, Eq. (13), for Young's modulus.

4.4 The general model

For isotropic materials, the elastic properties are fully described by any two of the elastic moduli. Polycrystalline ceramics usually are very good approximations to isotropic materials because of the randomness of the grain orientations, even when the individual grains are anisotropic. Except for textured materials in which the microstructure has partially aligned grain orientations, polycrystalline ceramics may be treated as isotropic materials.

Upon viewing the dependence on temperature and porosity separately, we have seen that the temperature dependence may be represented effectively by Eq. (12). For the porosity dependence, there are several alternatives, but only two of the models, Eq. (13) for the elastic modulus and Eq. (14) for the bulk modulus, have been derived in closed form from theoretical models. Combining these models in the manner of Eq. (10), we obtain the general model describing the simultaneous dependence of E and B on the variables T and ϕ.

$$E(T,\phi) = E_0(1 - aT)(1 - \phi)^n \quad \textbf{(15)}$$

$$B(T,\phi) = B_0(1 - bT)(1 - \phi)^m \quad \textbf{(16)}$$

The shear modulus, G, may be obtained from E and B as

$$G = \frac{3BE}{9B - E} \quad \textbf{(17)}$$

but generally will not be of the same analytical form as E and B. For ceramics, the magnitude of E is typically on the order of twice that of B. Consequently, the relation in Eq. (17) can be expanded as

$$G = \frac{1}{3} E \sum_{\varsigma=0}^{\infty} \left(\frac{E}{9B} \right)^{\varsigma} \quad \textbf{(18)}$$

yielding

$$G \approx \frac{1}{3} E \left[1 + \left(\frac{E}{9B} \right) + \left(\frac{E}{9B} \right)^2 + \cdots \right] \quad \textbf{(19)}$$

from which it is seen that G may have a different functional dependence on T and ϕ, depending on the ratio ($E/9B$).

Poisson's ratio, ν, is given by

$$\nu = \frac{1}{2} - \frac{E}{6B} \quad \textbf{(20)}$$

and depends directly on the ratio ($E/6B$). In Eqs. (15) and (16), the magnitudes of aT and bT are typically about 0.1 at 1000 °C. Hence, the ratio (E/B) is approximately

$$\frac{E}{B} \approx \frac{E_0}{B_0} \cdot (1 - [a - b]T)(1 - \phi)^{n-m} \quad \textbf{(21)}$$

Consequently, Poisson's ratio has a dependence on T and ϕ that reflects how the elastic modulus and the bulk modulus differ in their dependence on those variables.

5. Overview of the compilation

The data contained in this compilation were extracted from publicly accessible technical literature. Values reported numerically in the original papers usually have been listed with the same number of significant digits as originally reported. An exception to this rule occurred whenever the number of reported significant digits clearly was excessive compared to the number of digits that could reasonably be expected for the observed measurement uncertainty.

Data reported graphically in the original papers were extracted from the published figures using a mechanical digitization procedure. Since digitization is itself a measurement process, additional uncertainty must accrue to each individual point. To estimate this additional uncertainty under worst case conditions, replicate digitizations were performed on figures containing both well resolved and poorly resolved data points. The relative expanded uncertainty for the digitization process using a coverage factor of two (corresponding to a confidence level of approximately 95 %) was estimated to be

3 %.

While the goal has been to provide a comprehensive data set for each material, it is recognized that such a goal usually is unattainable. Where a comprehensive set has been unattainable, we have striven to provide at least a set representative of the available data. For some materials, phase or composition changes may have affected the measurement results. Data for such cases (readily identified by their unusual behavior) are included to the extent available. In this regard, we especially note the case of high temperature superconductors (HTS). There are many papers reporting anomalous results for ultrasonic wave propagation in HTS materials at cryogenic temperatures [61-72]. Those papers often focus on the anomaly and usually have not reported the quantitative behavior of the elastic moduli. While data appropriate to the present compilation, therefore, are not available in those papers, the results are still relevant to understanding the limitations and behavior of the elastic moduli of high temperature superconductors. Consequently, those papers are cited here as additional references [61-72] of potential use to the reader.

6. Acknowledgments

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8. Index of materials

Section	*Material Designation*	*Section*	*Material Designation*
9.1	Al_2O_3 { aluminum oxide }	9.28	Sc_2O_3 { scandium oxide }
9.2	$Al_6Si_2O_{13}$ { mullite }	9.29	SiO_2 { silica }
9.3	$BaZrO_3$ { barium zirconate }	9.30	$SmBa_2Cu_3O_{7-x}$ { Sm:123 }
9.4	BeO { beryllium oxide }	9.31	Sm_2O_3 {samarium oxide }
9.5	$Bi_2Sr_2CaCu_2O_{8+x}$ { Bi:2212 }	9.32	ThO_2 { thorium dioxide }
9.6	$Bi_{2-x}Pb_xSr_2CaCu_2O_{8+y}$ { Bi(Pb):2212 }	9.33	TiO_2 { titanium dioxide }
9.7	$Bi_{2-x}Pb_xSr_2Ca_2Cu_3O_{10-y}$ { Bi(Pb):2223 }	9.34	Tm_2O_3 { thulium oxide }
9.8	Dy_2O_3 { dysprosium oxide }	9.35	UO_2 {uranium dioxide }
9.9	Er_2O_3 { erbium oxide }	9.36	$YBa_2Cu_3O_{7-x}$ {Y:123 }
9.10	Gd_2O_3 { gadolinium oxide }	9.37	YBa_2ZrO_6 {yttrium barium zirconate}
9.11	HfO_2 { monoclinic hafnia }	9.38	Y_2O_3 { yttrium oxide }
9.12	$HfO_2 \cdot xEr_2O_3$ { partially stabilized hafnia }	9.39	$Y_2O_3 \cdot xThO_2$ { Th-doped yttria }
9.13	$HfO_2 \cdot xEu_2O_3$ { partially stabilized hafnia }	9.40	$Y_2O_3 \cdot xZrO_2$ { Zr-doped yttria }
9.14	$HfO_2 \cdot xY_2O_3$ { partially stabilized hafnia }	9.41	Yb_2O_3 { ytterbium oxide }
9.15	$HfO_2 \cdot xX_2O_3$ { partially stabilized hafnia }	9.42	ZnO { zinc oxide }
9.16	$HfO_2 \cdot xEr_2O_3$ { cubic hafnia }	9.43	ZrO_2 {monoclinic zirconia }
9.17	$HfO_2 \cdot xGd_2O_3$ { cubic hafnia }	9.44	$ZrO_2 \cdot xMgO$ {partially stabilized zirconia }
9.18	$HfO_2 \cdot xPr_2O_3$ { cubic hafnia }	9.45	$ZrO_2 \cdot xCaO$ {cubic zirconia }
9.19	$HfO_2 \cdot xTb_2O_3$ { cubic hafnia }	9.46	$ZrO_2 \cdot xPr_2O_3$ {cubic zirconia }
9.20	$HfO_2 \cdot xY_2O_3$ { cubic hafnia }	9.47	$ZrO_2 \cdot xTb_2O_3$ {cubic zirconia }
9.21	$HfO_2 \cdot xX_2O_3$ { cubic hafnia }	9.48	$ZrO_2 \cdot xY_2O_3$ {cubic zirconia }
9.22	Ho_2O_3 { holmium oxide }	9.49	$ZrO_2 \cdot xY_2O_3 \cdot yFe_2O_3$ {cubic zirconia }
9.23	$La_{2-x}Sr_xCuO_{4-y}$ { La(Sr):21 }	9.50	$ZrO_2 \cdot xX_2O_3$ {cubic zirconia }
9.24	Lu_2O_3 { lutetium oxide }	9.51	$ZrO_2 \cdot xCeO_2$ {tetragonal zirconia, TZP }
9.25	$MgAl_2O_4$ { magnesium aluminate spinel }	9.52	$ZrO_2 \cdot xEr_2O_3$ {tetragonal zirconia, TZP }
9.26	MgO { magnesium oxide }	9.53	$ZrO_2 \cdot xY_2O_3$ {tetragonal zirconia, TZP }
9.27	$PrBa_2Cu_3O_{7-x}$ { Pr:123 }		

9. Data

The data are organized alphabetically by the chemical formula of the material. Each material begins a new subsection. For example, the subsection for the first material, alumina, is labeled: 9.1 Al_2O_3 { aluminum oxide, alumina }.

The first component of each subsection is an introductory page providing descriptive information, including the chemical formula, generic name(s), relative molecular mass M_r (*a.k.a.* molecular weight), and theoretical density ρ_{theo} (*a.k.a.* single crystal density and x-ray density). When sufficient data have been available, the parameters determined by fitting Eq. (15) and Eq. (16) to the data are also listed. Since the reported data actually pertain to E and G, the nonlinear fitting routine is applied to Eqs. (15) and (17) and using Eq. (16) for B. When the data are inadequate, it is sometimes possible to obtain useful estimates by combining data sets for similar materials (which might, for example, use different sintering aids or stabilizers). Values estimated in this manner are indicated by values in curly brackets, { }.

The second component of each subsection, contained also on the introductory page, is a collection of graphs showing, as available, the porosity dependence at room temperature, the temperature dependence at fixed porosity, and the fit of Eqs. (15) and (16). When the data set has been adequate for fitting the model, solid curves represent the fits to E and G and dashed curves for the derived quantities, B and ν. When other noted approximations have been needed to estimate the parameters in the model, the results are shown as dashed curves.

The third and final component of the information set is a table of data giving the property values as extracted from the references. The data tables are labeled with the number of the subsection and the table page sequence number. For example, the pages in the data table for alumina are labeled from 9.1.1 through 9.1.16. Indicated in each table are the measurement method, the exhibit type (graph, table, or text), the exhibit number (figure number, table number, or page number), the value type (experimental, smoothed, or calculated), the measurement condition (temperature), the material condition (density or porosity), and the corresponding property value.

Further information regarding the composition and processing of individual specimens may be given in footnotes to the tables. Footnote numbers are cited in the column labeled Ft.Nt. in the data tables. Footnotes immediately follow the end of the table in which they are cited.

Summary of the symbols used in the tables and figures:

M_r : relative molecular mass (*a.k.a.* molecular weight)
ρ_{theo} : theoretical density (*a.k.a.* single crystal density, x-ray density)

E_o, a, n : parameters for Eq. (15)*.
B_o, b, m : parameters for Eq. (16)*.
*Values in {} are estimated with additional assumptions.

x : experimental data
s : smoothed values
c : calculated values

E_{bend} : The subscript "bend" is used in some figures to denote a static modulus determined by means of a bend test.

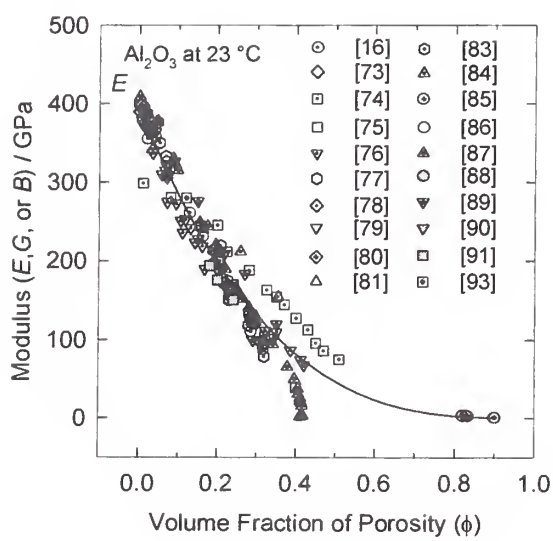
n/a : not available (usually due to insufficient data)

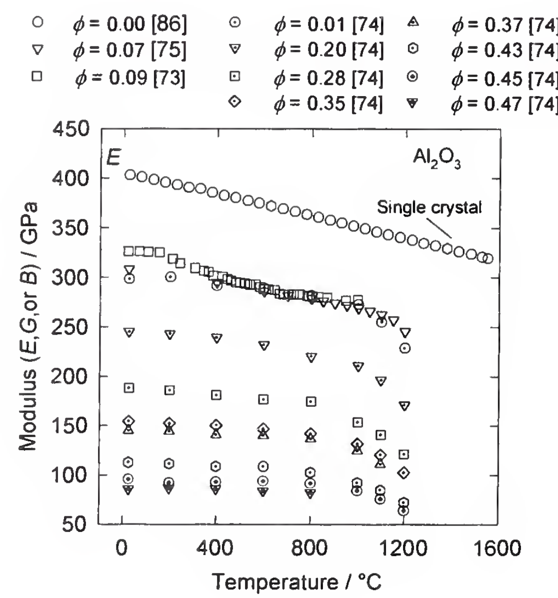
3pt : three-point
4pt : four-point
flex. : flexure
meth : method
rec.par. : rectangular parallelepiped
res. : resonance
SAWS : surface acoustic wave spectroscopy
ult. : ultrasonic

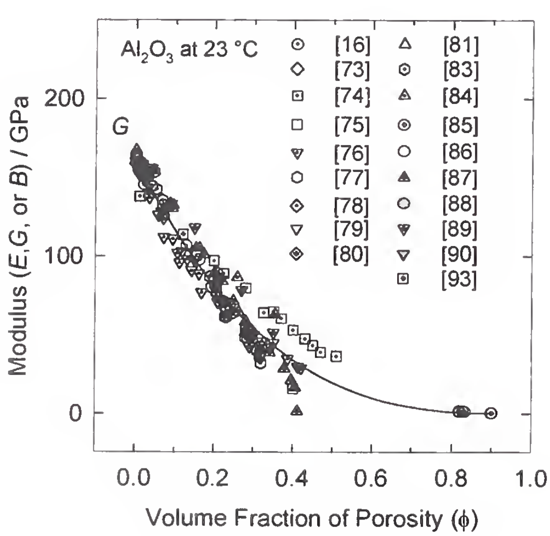
Ref. Nbr. : reference number
Exh. Type : exhibit type
Mtl. Nbr. : material number
Vol. Frac. : volume fraction
Ft. Nt. : foot note
Exh. Nbr. : exhibit number
T : temperature
Long. : longitudinal

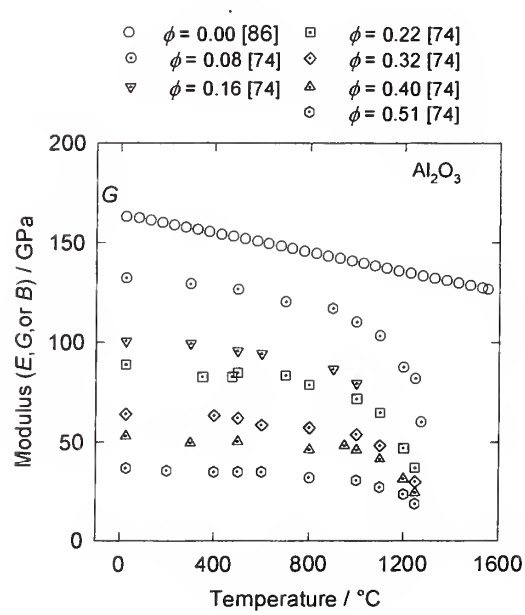
9.1 Al_2O_3 { aluminum oxide, alumina }

M_r / (g mol^{-1}) = 101.961	Temperature range / (°C) = 0 to 1000	
ρ_{theo} / (g cm^{-3}) = 3.984	Porosity range = 0 to 0.9	
	E_o / (GPa) = 393	B_o / (GPa) = 241
	a / (10^{-4}°C) = 1.33	b / (10^{-4}°C) = 0.84
	n = 3.06	m = 3.33









Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
16	Table	6	x	resonance	1	23	3.942				395.8	156.5	264.5	0.254	
16	Table	6	x	resonance	2	23	3.904				355.5	145.3	212.9	0.221	
16	Table	6	x	resonance	3	23	3.902				382.4	154.8	241.5	0.236	
16	Table	6	x	resonance	4	23	3.824				358.3	143.8	234.9	0.246	
16	Table	6	x	resonance	5	23	3.825				358.0	144.5	228.9	0.239	
16	Table	6	x	resonance	6	23	3.714				325.5	132.1	201.8	0.232	
16	Table	6	x	resonance	7	23	3.470				261.2	106.7	157.9	0.224	
16	Table	6	x	resonance	8	23	3.335				231.7	97.7	123.5	0.187	
16	Table	6	x	resonance	9	23	2.850				110.9	47.9	53.3	0.17	
73	Graph	2	x	sonic resonance		20	3.64	0.09			326.6				1
73	Graph	2	x	sonic resonance		67					326.6				1
73	Graph	2	x	sonic resonance		105					326.0				1
73	Graph	2	x	sonic resonance		152					325.4				1
73	Graph	2	x	sonic resonance		210					319.1				1
73	Graph	2	x	sonic resonance		242					314.6				1
73	Graph	2	x	sonic resonance		305					309.5				1
73	Graph	2	x	sonic resonance		342					306.6				1
73	Graph	2	x	sonic resonance		363					305.5				1
73	Graph	2	x	sonic resonance		384					302.0				1
73	Graph	2	x	sonic resonance		422					300.9				1
73	Graph	2	x	sonic resonance		443					298.6				1
73	Graph	2	x	sonic resonance		459					296.9				1
73	Graph	2	x	sonic resonance		480					295.2				1
73	Graph	2	x	sonic resonance		497					294.6				1
73	Graph	2	x	sonic resonance		518					294.0				1
73	Graph	2	x	sonic resonance		539					292.9				1
73	Graph	2	x	sonic resonance		564					292.9				1
73	Graph	2	x	sonic resonance		581					290.6				1
73	Graph	2	x	sonic resonance		597					288.3				1
73	Graph	2	x	sonic resonance		618					288.3				1
73	Graph	2	x	sonic resonance		643					287.2				1

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
73	Graph	2	x	sonic resonance		664					283.8				1
73	Graph	2	x	sonic resonance		681					283.2				1
73	Graph	2	x	sonic resonance		702					283.2				1
73	Graph	2	x	sonic resonance		723					283.2				1
73	Graph	2	x	sonic resonance		749					283.2				1
73	Graph	2	x	sonic resonance		782					281.4				1
73	Graph	2	x	sonic resonance		803					280.9				1
73	Graph	2	x	sonic resonance		828					280.3				1
73	Graph	2	x	sonic resonance		866					279.7				1
73	Graph	2	x	sonic resonance		946					276.8				1
73	Graph	2	x	sonic resonance		997					277.4				1
73	Graph	2	x	sonic resonance		964					279.1				2
73	Graph	2	x	sonic resonance		867					280.8				2
73	Graph	2	x	sonic resonance		804					282.6				2
73	Graph	2	x	sonic resonance		765					282.6				2
73	Graph	2	x	sonic resonance		702					281.5				2
73	Graph	2	x	sonic resonance		659					282.1				2
73	Graph	2	x	sonic resonance		601					286.6				2
73	Graph	2	x	sonic resonance		559					288.4				2
73	Graph	2	x	sonic resonance		500					292.4				2
73	Graph	2	x	sonic resonance		24					324.9				2
74	Table	II	x	bending		25		0						0.27	
74	Table	II	x	bending		25		0.1						0.26	
74	Table	II	x	bending		25		0.2						0.32	
74	Table	II	x	bending		25		0.3						0.29	
74	Table	II	x	bending		25		0.4						0.25	
74	Table	II	x	bending		25		0.5						0.13	
74	Table	II	x	bending		600		0							
74	Table	II	x	bending		600		0.1							
74	Table	II	x	bending		600		0.2							
74	Table	II	x	bending		600		0.3							
74	Table	II	x	bending		600		0.4							

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
74	Table	II	x	bending		600		0.5							
74	Table	II	x	bending		800		0							
74	Table	II	x	bending		800		0.1							
74	Table	II	x	bending		800		0.2							
74	Table	II	x	bending		800		0.3							
74	Table	II	x	bending		800		0.4							
74	Table	II	x	bending		800		0.5							
74	Table	II	x	bending		1000		0							
74	Table	II	x	bending		1000		0.1							
74	Table	II	x	bending		1000		0.2							
74	Table	II	x	bending		1000		0.3							
74	Table	II	x	bending		1000		0.4							
74	Table	II	x	bending		1000		0.5							
74	Table	II	x	bending		1200		0							
74	Table	II	x	bending		1200		0.1							
74	Table	II	x	bending		1200		0.2							
74	Table	II	x	bending		1200		0.3							
74	Table	II	x	bending		1200		0.4							
74	Table	II	x	bending		1200		0.5							
74	Graph	5	x	bending		25		0.01			298.5				
74	Graph	5	x	bending		200		0.01			300.6				
74	Graph	5	x	bending		400		0.01			291.6				
74	Graph	5	x	bending		600		0.01			289.5				
74	Graph	5	x	bending		800		0.01			282.0				
74	Graph	5	x	bending		1000		0.01			273.0				
74	Graph	5	x	bending		1100		0.01			255.1				
74	Graph	5	x	bending		1200		0.01			228.9				
74	Graph	5	x	bending		25		0.2			245.4				
74	Graph	5	x	bending		200		0.2			243.4				
74	Graph	5	x	bending		400		0.2			239.9				
74	Graph	5	x	bending		600		0.2			232.3				
74	Graph	5	x	bending		800		0.2			220.6				
74	Graph	5	x	bending		1000		0.2			211.0				

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
74	Graph	5	x	bending		1100		0.2			196.5				
74	Graph	5	x	bending		1200		0.2			171.7				
74	Graph	5	x	bending		25		0.28			188.2				
74	Graph	5	x	bending		200		0.28			186.1				
74	Graph	5	x	bending		400		0.28			181.3				
74	Graph	5	x	bending		600		0.28			176.5				
74	Graph	5	x	bending		800		0.28			174.4				
74	Graph	5	x	bending		1000		0.28			153.7				
74	Graph	5	x	bending		1100		0.28			140.6				
74	Graph	5	x	bending		1200		0.28			121.3				
74	Graph	5	x	bending		25		0.35			154.4				
74	Graph	5	x	bending		200		0.35			152.4				
74	Graph	5	x	bending		400		0.35			150.3				
74	Graph	5	x	bending		600		0.35			146.8				
74	Graph	5	x	bending		800		0.35			142.0				
74	Graph	5	x	bending		1000		0.35			131.7				
74	Graph	5	x	bending		1100		0.35			120.6				
74	Graph	5	x	bending		1200		0.35			102.7				
74	Graph	5	x	bending		25		0.37			144.8				
74	Graph	5	x	bending		200		0.37			144.1				
74	Graph	5	x	bending		400		0.37			140.6				
74	Graph	5	x	bending		600		0.37			139.9				
74	Graph	5	x	bending		800		0.37			136.5				
74	Graph	5	x	bending		1000		0.37			124.8				
74	Graph	5	x	bending		1100		0.37			111.0				
74	Graph	5	x	bending		25		0.43			113.1				
74	Graph	5	x	bending		200		0.43			111.7				
74	Graph	5	x	bending		400		0.43			108.9				
74	Graph	5	x	bending		600		0.43			108.9				
74	Graph	5	x	bending		800		0.43			102.7				
74	Graph	5	x	bending		1000		0.43			92.4				
74	Graph	5	x	bending		1100		0.43			84.8				
74	Graph	5	x	bending		1200		0.43			72.4				

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
74	Graph	5	x	bending		25		0.45			95.8				
74	Graph	5	x	bending		200		0.45			92.4				
74	Graph	5	x	bending		400		0.45			93.1				
74	Graph	5	x	bending		600		0.45			93.8				
74	Graph	5	x	bending		800		0.45			91.7				
74	Graph	5	x	bending		1000		0.45			84.1				
74	Graph	5	x	bending		1100		0.45			75.8				
74	Graph	5	x	bending		1200		0.45			64.1				
74	Graph	5	x	bending		25		0.47			86.2				
74	Graph	5	x	bending		200		0.47			86.9				
74	Graph	5	x	bending		400		0.47			86.2				
74	Graph	5	x	bending		600		0.47			84.1				
74	Graph	5	x	bending		800		0.47			82.0				
74	Graph	7	x	bending		25		0.08				132.4			
74	Graph	7	x	bending		300		0.08				129.6			
74	Graph	7	x	bending		500		0.08				126.8			
74	Graph	7	x	bending		700		0.08				120.6			
74	Graph	7	x	bending		900		0.08				117.2			
74	Graph	7	x	bending		1000		0.08				110.3			
74	Graph	7	x	bending		1100		0.08				103.4			
74	Graph	7	x	bending		1200		0.08				87.6			
74	Graph	7	x	bending		1250		0.08				82			
74	Graph	7	x	bending		1275		0.08				60			
74	Graph	7	x	bending		25		0.155				100.7			
74	Graph	7	x	bending		300		0.155				99.3			
74	Graph	7	x	bending		500		0.155				95.8			
74	Graph	7	x	bending		600		0.155				94.4			
74	Graph	7	x	bending		900		0.155				86.9			
74	Graph	7	x	bending		1000		0.155				79.3			
74	Graph	7	x	bending		25		0.224				88.9			
74	Graph	7	x	bending		350		0.224				82.7			
74	Graph	7	x	bending		475		0.224				82.7			
74	Graph	7	x	bending		500		0.224				84.8			

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
74	Graph	7	x	bending		700		0.224				83.4			
74	Graph	7	x	bending		800		0.224				78.6			
74	Graph	7	x	bending		1000		0.224				71.7			
74	Graph	7	x	bending		1100		0.224				64.8			
74	Graph	7	x	bending		1200		0.224				46.9			
74	Graph	7	x	bending		1250		0.224				36.5			
74	Graph	7	x	bending		25		0.325				64.1			
74	Graph	7	x	bending		400		0.325				63.4			
74	Graph	7	x	bending		500		0.325				62			
74	Graph	7	x	bending		600		0.325				58.6			
74	Graph	7	x	bending		800		0.325				57.2			
74	Graph	7	x	bending		1000		0.325				53.8			
74	Graph	7	x	bending		1100		0.325				48.3			
74	Graph	7	x	bending		1250		0.325				29.6			
74	Graph	7	x	bending		25		0.4				53.1			
74	Graph	7	x	bending		300		0.4				49.6			
74	Graph	7	x	bending		500		0.4				50.3			
74	Graph	7	x	bending		800		0.4				46.2			
74	Graph	7	x	bending		950		0.4				48.3			
74	Graph	7	x	bending		1000		0.4				46.2			
74	Graph	7	x	bending		1100		0.4				41.4			
74	Graph	7	x	bending		1200		0.4				31			
74	Graph	7	x	bending		1250		0.4				24.1			
74	Graph	7	x	bending		25		0.51				36.5			
74	Graph	7	x	bending		200		0.51				35.2			
74	Graph	7	x	bending		400		0.51				34.5			
74	Graph	7	x	bending		500		0.51				34.5			
74	Graph	7	x	bending		600		0.51				34.5			
74	Graph	7	x	bending		800		0.51				31.7			
74	Graph	7	x	bending		1000		0.51				30.3			
74	Graph	7	x	bending		1100		0.51				26.9			
74	Graph	7	x	bending		1200		0.51				23.4			
74	Graph	7	x	bending		1250		0.51				18.6			

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
75	Table	II	x	sonic resonance		23	3.71				309				
75	Graph	3	x	sonic resonance		23	3.71				308.5				
75	Graph	3	x	sonic resonance		400					294.9				
75	Graph	3	x	sonic resonance		600					286.4				
75	Graph	3	x	sonic resonance		700					281.9				
75	Graph	3	x	sonic resonance		800					278.9				
75	Graph	3	x	sonic resonance		850					276.4				
75	Graph	3	x	sonic resonance		900					274.4				
75	Graph	3	x	sonic resonance		950					272.3				
75	Graph	3	x	sonic resonance		1000					269.3				
75	Graph	3	x	sonic resonance		1050					265.8				
75	Graph	3	x	sonic resonance		1100					262.8				
75	Graph	3	x	sonic resonance		1150					257.3				
75	Graph	3	x	sonic resonance		1200					245.7				
76	Graph	1	x	dynamic	1	23		0.006			379				3
76	Graph	1	x	dynamic	1	23		0.008			374				3
76	Graph	1	x	dynamic	1	23		0.011			374				3
76	Graph	1	x	dynamic	1	23		0.022			363				3
76	Graph	1	x	dynamic	1	23		0.034			337				3
76	Graph	1	x	dynamic	1	23		0.065			315				3
76	Graph	1	x	dynamic	1	23		0.106			251				3
76	Graph	1	x	dynamic	1	23		0.118			253				3
76	Graph	1	x	dynamic	1	23		0.131			242				3
76	Graph	1	x	dynamic	1	23		0.161			219				3
76	Graph	1	x	dynamic	1	23		0.168			190				3
76	Graph	1	x	dynamic	1	23		0.206			185				3
76	Graph	1	x	dynamic	1	23		0.231			153				3
76	Graph	1	x	dynamic	1	23		0.300			122				3
76	Graph	1	x	dynamic	1	23		0.321			112				3
76	Graph	1	x	static	2	23		0.023			368				4
76	Graph	1	x	static	2	23		0.057			310				4

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
76	Graph	1	x	static	2	23		0.071			275				4
76	Graph	1	x	static	2	23		0.094			273				4
76	Graph	1	x	static	2	23		0.111			236				4
76	Graph	1	x	static	2	23		0.142			224				4
76	Graph	1	x	static	2	23		0.209			174				4
76	Graph	1	x	static	3	23		0.070			306				5
76	Graph	1	x	static	3	23		0.205			213				5
76	Graph	1	x	static	3	23		0.217			209				5
76	Graph	1	x	static	3	23		0.343			103				5
76	Graph	1	x	static	4	23		0.285			124				6
76	Graph	1	x	static	4	23		0.350			110				6
76	Graph	1	x	static	4	23		0.386			87.1				6
76	Graph	1	x	static	4	23		0.412			74.8				6
77	Graph	2	x	4pt bending		30					388				
78	Table	1	x	sonic	1	23	3.98				390				
78	Table	1	x	sonic	2	23	3.94				391				
78	Table	1	x	sonic	3	23	3.87				369				
78	Table	1	x	sonic	4	23	3.87				375				
79	Table	III	x	ult. interferometry		25	3.972		10.845	6.373	398.86	161.32	252.06	0.2363	
80	Table	I	x	dynamic res.	1	25	3.972	0.0035			398.5	161.6	248.7		
80	Table	I	x	dynamic res.	2	25	3.941	0.0113			385.3	157.5	231.8		
81	Table	I	x	ultrasonic res.		25	3.974		10.845	6.377		161.6	251.92		
82	Graph	3	x	ult. pulse echo		23		0.010		6.31					
82	Graph	3	x	ult. pulse echo		23		0.029		6.18					
82	Graph	3	x	ult. pulse echo		23		0.050		6.15					
82	Graph	3	x	ult. pulse echo		23		0.060		6.03					
82	Graph	3	x	ult. pulse echo		23		0.074		5.93					

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
82	Graph	3	x	ult. pulse echo		23		0.091		6.03					
82	Graph	3	x	ult. pulse echo		23		0.108		5.84					
82	Graph	3	x	ult. pulse echo		23		0.122		5.72					
82	Graph	3	x	ult. pulse echo		23		0.132		5.85					
82	Graph	3	x	ult. pulse echo		23		0.141		5.62					
82	Graph	3	x	ult. pulse echo		23		0.201		5.54					
82	Graph	3	x	ult. pulse echo		23		0.211		5.41					
82	Graph	3	x	ult. pulse echo		23		0.244		5.29					
82	Graph	3	x	ult. pulse echo		23		0.268		5.10					
82	Graph	3	x	ult. pulse echo		23		0.325		5.01					
82	Graph	3	x	ult. pulse echo		23		0.363		4.86					
82	Graph	3	x	ult. pulse echo		23		0.402		4.61					
82	Graph	4	x	ult. pulse echo		23		0.007	9.80						
82	Graph	4	x	ult. pulse echo		23		0.033	9.80						
82	Graph	4	x	ult. pulse echo		23		0.050	9.64						
82	Graph	4	x	ult. pulse echo		23		0.074	9.17						
82	Graph	4	x	ult. pulse echo		23		0.102	9.02						
82	Graph	4	x	ult. pulse echo		23		0.105	9.33						
82	Graph	4	x	ult. pulse echo		23		0.112	9.09						
82	Graph	4	x	ult. pulse echo		23		0.121	8.94						
82	Graph	4	x	ult. pulse echo		23		0.129	9.17						
82	Graph	4	x	ult. pulse echo		23		0.140	8.78						
82	Graph	4	x	ult. pulse echo		23		0.200	8.47						
82	Graph	4	x	ult. pulse echo		23		0.207	8.86						
82	Graph	4	x	ult. pulse echo		23		0.248	8.23						
82	Graph	4	x	ult. pulse echo		23		0.324	7.84						
82	Graph	4	x	ult. pulse echo		23		0.360	7.30						
82	Graph	4	x	ult. pulse echo		23		0.398	6.91						
83	Graph	4	x	sonic velocity	1	23		0.226			175.4				
83	Graph	4	x	sonic velocity	1	23		0.228			166.9				
83	Graph	4	x	sonic velocity	1	23		0.231			161.1				
83	Graph	4	x	sonic velocity	1	23		0.249			157.8				

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
83	Graph	4	x	sonic velocity	1	23		0.31			98.1				
83	Graph	4	x	sonic velocity	1	23		0.315			92.8				
83	Graph	4	x	sonic velocity	1	23		0.316			94.7				
83	Graph	4	x	sonic velocity	1	23		0.318			96				
83	Graph	4	x	3pt bending	1	23		0.067			333.1				
83	Graph	4	x	3pt bending	1	23		0.069			310.6				
83	Graph	4	x	3pt bending	1	23		0.228			150.9				
83	Graph	4	x	3pt bending	1	23		0.231			150.9				
83	Graph	4	x	3pt bending	1	23		0.316			88.6				
83	Graph	4	x	3pt bending	1	23		0.318			78.6				
83	Graph	4	x	sonic velocity	2	23		0.188			214.1				
83	Graph	4	x	sonic velocity	2	23		0.208			219.6				
83	Graph	4	x	sonic velocity	2	23		0.206			200.4				
83	Graph	4	x	sonic velocity	2	23		0.205			189.4				
83	Graph	4	x	sonic velocity	2	23		0.28			136.3				
83	Graph	4	x	sonic velocity	2	23		0.281			132.3				
83	Graph	4	x	sonic velocity	2	23		0.29			121				
83	Graph	4	x	sonic velocity	2	23		0.292			128.6				
83	Graph	4	x	3pt bending	2	23		0.047			376.8				
83	Graph	4	x	3pt bending	2	23		0.052			350				
83	Graph	4	x	3pt bending	2	23		0.192			197.6				
83	Graph	4	x	3pt bending	2	23		0.201			200.4				
83	Graph	4	x	3pt bending	2	23		0.279			118.9				
83	Graph	4	x	3pt bending	2	23		0.283			127.4				
84	Graph	13	x	ult. pulse echo		23		0.032			342				
84	Graph	13	x	ult. pulse echo		23		0.077			322				
84	Graph	13	x	ult. pulse echo		23		0.259			212				
84	Graph	13	x	ult. pulse echo		23		0.354			155				
85	Graph	4	x	sonic resonance		23	0.393				0.98				
85	Graph	4	x	sonic resonance		23	0.403				1.02				
85	Graph	4	x	sonic resonance		23	0.663				2.95				

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
85	Graph	4	x	sonic resonance		23	0.682				3.35				
85	Graph	4	x	sonic resonance		23	0.682				3.67				
85	Graph	4	x	sonic resonance		23	0.721				3.74				
85	Graph	4	x	sonic resonance		23	0.717				3.48				
85	Graph	4	x	sonic resonance		23	0.714				3.18				
86	Table	2	x	resonance		23	3.982				403.0	163.1	253.7	0.2353	7
86	Table	2	x	resonance		77					400.9	162.2	253.3	0.2362	7
86	Table	2	x	resonance		127					398.5	161.1	252.6	0.2371	7
86	Table	2	x	resonance		177					396.0	160.0	251.8	0.2378	7
86	Table	2	x	resonance		227					393.5	158.8	250.9	0.2386	7
86	Table	2	x	resonance		277					390.8	157.7	249.7	0.2391	7
86	Table	2	x	resonance		327					389.3	156.6	248.6	0.2397	7
86	Table	2	x	resonance		377					385.6	155.4	247.7	0.2406	7
86	Table	2	x	resonance		427					382.8	154.2	246.6	0.2412	7
86	Table	2	x	resonance		477					380.2	153.1	245.5	0.2419	7
86	Table	2	x	resonance		527					377.4	151.9	244.4	0.2426	7
86	Table	2	x	resonance		577					374.7	150.7	243.3	0.2433	7
86	Table	2	x	resonance		627					372.0	149.5	242.4	0.2443	7
86	Table	2	x	resonance		677					369.2	148.3	241.3	0.2450	7
86	Table	2	x	resonance		727					366.4	147.1	240	0.2456	7
86	Table	2	x	resonance		777					363.5	145.8	238.9	0.2464	7
86	Table	2	x	resonance		827					360.7	144.6	237.8	0.2472	7
86	Table	2	x	resonance		877					357.9	143.4	236.6	0.2479	7
86	Table	2	x	resonance		927					355.0	142.2	235.2	0.2484	7
86	Table	2	x	resonance		977					352.0	140.9	233.9	0.2492	7
86	Table	2	x	resonance		1027					349.1	139.7	232.6	0.2499	7
86	Table	2	x	resonance		1077					346.1	138.4	231	0.2503	7
86	Table	2	x	resonance		1127					343.3	137.2	230	0.2513	7
86	Table	2	x	resonance		1177					340.5	136.0	228.8	0.2519	7
86	Table	2	x	resonance		1227					337.8	134.8	228.1	0.2533	7
86	Table	2	x	resonance		1277					334.9	133.5	226.8	0.2539	7
86	Table	2	x	resonance		1327					332.1	132.3	225.9	0.2550	7

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
86	Table	2	x	resonance		1377					329.5	131.2	224.8	0.2558	7
86	Table	2	x	resonance		1427					326.6	130.0	223.6	0.2566	7
86	Table	2	x	resonance		1477					323.8	128.7	222.3	0.2577	7
86	Table	2	x	resonance		1527					320.9	127.5	221.8	0.2589	7
86	Table	2	x	resonance		1552					319.5	126.8	221.3	0.2594	7
87	Graph	2	x	sonic resonance		23		0.411			1.62				
87	Graph	2	x	sonic resonance		23		0.418			3.19				
87	Graph	2	x	sonic resonance		23		0.412			3.36				
87	Graph	2	x	sonic resonance		23		0.416			15.7				
87	Graph	2	x	sonic resonance		23		0.414			19.6				
87	Graph	2	x	sonic resonance		23		0.412			22.6				
87	Graph	2	x	sonic resonance		23		0.411			26.3				
87	Graph	2	x	sonic resonance		23		0.406			31.1				
87	Graph	2	x	sonic resonance		23		0.405			37.8				
87	Graph	2	x	sonic resonance		23		0.396			50.2				
87	Graph	2	x	sonic resonance		23		0.378			65.6				
87	Graph	2	x	sonic resonance		23		0.341			94.7				
87	Graph	2	x	sonic resonance		23		0.296			123				
87	Graph	2	x	sonic resonance		23		0.297			130				
87	Graph	2	x	sonic resonance		23		0.287			123				
87	Graph	2	x	sonic resonance		23		0.28			141				
87	Graph	2	x	sonic resonance		23		0.264			152				
87	Graph	2	x	sonic resonance		23		0.251			160				
87	Graph	2	x	sonic resonance		23		0.248			166				
87	Graph	2	x	sonic resonance		23		0.221			190				
87	Graph	2	x	sonic resonance		23		0.201			194				
87	Graph	2	x	sonic resonance		23		0.201			210				
87	Graph	2	x	sonic resonance		23		0.196			221				
87	Graph	2	x	sonic resonance		23		0.175			244				
87	Graph	2	x	sonic resonance		23		0.163			240				
87	Graph	2	x	sonic resonance		23		0.155			249				
87	Graph	2	x	sonic resonance		23		0.098			315				

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
87	Graph	2	x	sonic resonance		23		0.092			322				
87	Graph	2	x	sonic resonance		23		0.086			330				
87	Graph	2	x	sonic resonance		23		0.046			378				
87	Graph	2	x	sonic resonance		23		0.042			377				
87	Graph	2	x	sonic resonance		23		0.001			409				
87	Graph	2	x	sonic resonance		23		0.411				1.48			
87	Graph	2	x	sonic resonance		23		0.405				16.5			
87	Graph	2	x	sonic resonance		23		0.395				21.3			
87	Graph	2	x	sonic resonance		23		0.378				28.6			
87	Graph	2	x	sonic resonance		23		0.341				38.7			
87	Graph	2	x	sonic resonance		23		0.295				53			
87	Graph	2	x	sonic resonance		23		0.28				58.6			
87	Graph	2	x	sonic resonance		23		0.262				64.7			
87	Graph	2	x	sonic resonance		23		0.249				71.5			
87	Graph	2	x	sonic resonance		23		0.221				84.1			
87	Graph	2	x	sonic resonance		23		0.201				89.3			
87	Graph	2	x	sonic resonance		23		0.174				101			
87	Graph	2	x	sonic resonance		23		0.163				105			
87	Graph	2	x	sonic resonance		23		0.154				105			
87	Graph	2	x	sonic resonance		23		0.095				132			
87	Graph	2	x	sonic resonance		23		0.092				130			
87	Graph	2	x	sonic resonance		23		0.087				133			
87	Graph	2	x	sonic resonance		23		0.047				154			
87	Graph	2	x	sonic resonance		23		0.042				154			
87	Graph	2	x	sonic resonance		23		0.001				167			
87	Graph	2	x	sonic resonance		23		0.412					1.58		
87	Graph	2	x	sonic resonance		23		0.411					3.26		
87	Graph	2	x	sonic resonance		23		0.405					18		
87	Graph	2	x	sonic resonance		23		0.396					23		
87	Graph	2	x	sonic resonance		23		0.378					32.1		
87	Graph	2	x	sonic resonance		23		0.341					45.6		
87	Graph	2	x	sonic resonance		23		0.299					65.7		
87	Graph	2	x	sonic resonance		23		0.28					69.8		

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
87	Graph	2	x	sonic resonance		23		0.265					78.1		
87	Graph	2	x	sonic resonance		23		0.25					83		
87	Graph	2	x	sonic resonance		23		0.222					91.4		
87	Graph	2	x	sonic resonance		23		0.196					116		
87	Graph	2	x	sonic resonance		23		0.175					117		
87	Graph	2	x	sonic resonance		23		0.156					126		
87	Graph	2	x	sonic resonance		23		0.097					172		
87	Graph	2	x	sonic resonance		23		0.087					171		
87	Graph	2	x	sonic resonance		23		0.048					198		
87	Graph	2	x	sonic resonance		23		0.043					198		
87	Graph	2	x	sonic resonance		23		0.002					209		
87	Graph	3	x	sonic resonance		23		0.411						0.147	
87	Graph	3	x	sonic resonance		23		0.404						0.156	
87	Graph	3	x	sonic resonance		23		0.395						0.158	
87	Graph	3	x	sonic resonance		23		0.376						0.161	
87	Graph	3	x	sonic resonance		23		0.339						0.169	
87	Graph	3	x	sonic resonance		23		0.296						0.162	
87	Graph	3	x	sonic resonance		23		0.293						0.15	
87	Graph	3	x	sonic resonance		23		0.284						0.142	
87	Graph	3	x	sonic resonance		23		0.284						0.137	
87	Graph	3	x	sonic resonance		23		0.278						0.179	
87	Graph	3	x	sonic resonance		23		0.262						0.171	
87	Graph	3	x	sonic resonance		23		0.247						0.165	
87	Graph	3	x	sonic resonance		23		0.246						0.172	
87	Graph	3	x	sonic resonance		23		0.218						0.166	
87	Graph	3	x	sonic resonance		23		0.2						0.166	
87	Graph	3	x	sonic resonance		23		0.197						0.177	
87	Graph	3	x	sonic resonance		23		0.193						0.193	
87	Graph	3	x	sonic resonance		23		0.173						0.171	
87	Graph	3	x	sonic resonance		23		0.161						0.177	
87	Graph	3	x	sonic resonance		23		0.152						0.182	
87	Graph	3	x	sonic resonance		23		0.096						0.2	
87	Graph	3	x	sonic resonance		23		0.091						0.201	

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
87	Graph	3	x	sonic resonance		23		0.085						0.19	
87	Graph	3	x	sonic resonance		23		0.046						0.201	
87	Graph	3	x	sonic resonance		23		0.042						0.191	
87	Graph	3	x	sonic resonance		23		0.003						0.209	
87	Graph	3	x	sonic resonance		23		0.002						0.197	
87	Graph	3	x	sonic resonance		23		0.003						0.184	
87	Graph	3	x	sonic resonance		23		0.001						0.18	
88	Table	P4	x	ultrasonic meth.		23	3.98				398	159		0.245	
89	Table	I	x	sonic velocity		23		0.29		calc.val.->	100		50.5	0.17	
89	Table	I	x	sonic velocity		23		0.22		calc.val.->	168		84.8	0.17	
89	Table	I	x	sonic velocity		23		0.15		calc.val.->	228		115.2	0.17	
89	Table	I	x	sonic velocity		23		0.04		calc.val.->	364		183.8	0.17	
89	Table	I	x	sonic velocity		23		0.42		calc.val.->	68		34.3	0.17	
89	Table	I	x	sonic velocity		23		0.35		calc.val.->	120		60.6	0.17	
89	Table	I	x	sonic velocity		23		0.27		calc.val.->	184		92.9	0.17	
89	Table	I	x	sonic velocity		23		0.15		calc.val.->	276		139.4	0.17	
90	Table	1,2	x	ultrasonic res.		23	3.98	0.002			393	158		0.24	
91	Graph	9	x	sonic velocity		23		0.24			151				
91	Graph	9	x	sonic velocity		23		0.20			176				
91	Graph	9	x	sonic velocity		23		0.18			194				
92	Table	I	x	ultrasonic res.		25					436				
92	Table	I	x	ultrasonic res.		340					402				
92	Table	I	x	ultrasonic res.		346					384				
92	Table	I	x	ultrasonic res.		390					379				
92	Table	I	x	ultrasonic res.		470					380				
92	Table	I	x	ultrasonic res.		490					377				
92	Table	I	x	ultrasonic res.		761					363				
92	Table	I	x	ultrasonic res.		800					357				

Al_2O_3 { aluminum oxide, alumina }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
92	Table	I	x	ultrasonic res.		945					289				
92	Table	I	x	ultrasonic res.		974					283				
92	Table	I	x	ultrasonic res.		1020					277				
92	Table	I	x	ultrasonic res.		1100					264				
92	Table	I	x	ultrasonic res.		1140					256				
92	Table	I	x	ultrasonic res.		1176					251				
92	Table	I	x	ultrasonic res.		1190					248				
92	Table	I	x	ultrasonic res.		1200					246				
93	Graph	3	x	sonic resonance		23					39				
93	Graph	3	x	sonic resonance		23					104				
93	Graph	3	x	sonic resonance		23					170				
93	Graph	3	x	sonic resonance		23					280				
93	Graph	3	x	sonic resonance		23					391				

Footnotes:

1: Heating

2: Cooling

3: Attributed to Spriggs

4: Attributed to Schofield

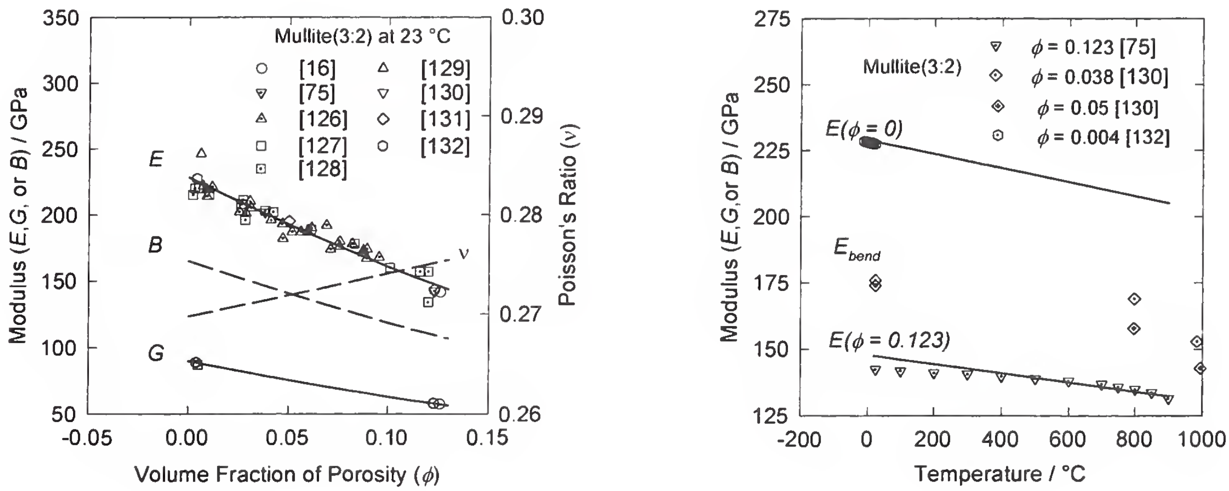
5: Attributed to Duckworth

6: Attributed to Majumder

7: G and B obtained *via* Voight-Reuss-Hill averaging of single crystal data; E calculated from G and B.

9.2 $Al_6Si_2O_{13}$ { mullite, mullite(3:2), $3Al_2O_3 \cdot 2SiO_2$ }

M_r / (g mol^{-1}) = 426.052 ρ_{theo} / (g cm^{-3}) = 3.17	Temperature range / (°C) = 0 to 900 Porosity range = 0 to 0.13	
	E_o / (GPa) = 229 a / (10^{-4}°C) = 1.17 n = 3.33	B_o / (GPa) = 166 b / (10^{-4}°C) = {1.16} m = 3.15



$Al_6Si_2O_{13}$ { mullite, mullite(3:2), $3Al_2O_3 \cdot 2SiO_2$ }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
16	Table	6	x	resonance	1	23	2.779				143.1	57.8	91.0	0.238	
16	Table	6	x	resonance	2	23	2.771				141.5	57.3	88.3	0.233	
75	Table	II	x	sonic resonance		23	2.78				143				
75	Graph	4	x	sonic resonance		23	2.78				142.5				
75	Graph	4	x	sonic resonance		100					142.0				
75	Graph	4	x	sonic resonance		200					141.2				
75	Graph	4	x	sonic resonance		300					140.7				
75	Graph	4	x	sonic resonance		400					139.9				
75	Graph	4	x	sonic resonance		500					139.1				
75	Graph	4	x	sonic resonance		600					138.2				
75	Graph	4	x	sonic resonance		700					137.0				
75	Graph	4	x	sonic resonance		750					135.9				
75	Graph	4	x	sonic resonance		800					135.1				
75	Graph	4	x	sonic resonance		850					133.9				
75	Graph	4	x	sonic resonance		900					131.6				
126	Graph	1	x	composite oscillator		23		0.0252			202				1
126	Graph	1	x	composite oscillator		23		0.0284			201				1
126	Graph	1	x	composite oscillator		23		0.0305			210				1
126	Graph	1	x	composite oscillator		23		0.0310			205				1
126	Graph	1	x	composite oscillator		23		0.0515			187				1
126	Graph	1	x	composite oscillator		23		0.0560			187				1
126	Graph	1	x	composite oscillator		23		0.0709			174				1
126	Graph	1	x	composite oscillator		23		0.0754			176				1
126	Graph	1	x	composite oscillator		23		0.0072			222				2
126	Graph	1	x	composite oscillator		23		0.0091			219				2
126	Graph	1	x	composite oscillator		23		0.0090			214				2
126	Graph	1	x	composite oscillator		23		0.0117			221				2
126	Graph	1	x	composite oscillator		23		0.0410			196				2
126	Graph	1	x	composite oscillator		23		0.0466			193				2
126	Graph	1	x	composite oscillator		23		0.0470			182				2

$Al_6Si_2O_{13}$ { mullite, mullite(3:2), $3Al_2O_3 \cdot 2SiO_2$ }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
126	Graph	1	x	composite oscillator		23		0.0592			187				2
126	Graph	1	x	composite oscillator		23		0.0612			190				2
126	Graph	1	x	composite oscillator		23		0.0688			192				2
126	Graph	1	x	composite oscillator		23		0.0755			180				2
126	Graph	1	x	composite oscillator		23		0.0818			178				2
126	Graph	1	x	composite oscillator		23		0.0893			174				2
126	Graph	1	x	composite oscillator		23		0.0874			173				2
126	Graph	1	x	composite oscillator		23		0.0873			171				2
126	Graph	1	x	composite oscillator		23		0.0891			167				2
126	Graph	1	x	composite oscillator		23		0.0955			168				2
127	Text	552	x	resonant sphere method		23	3.155				220	87	157	0.266	
128	Graph	5	x	ultrasonic method		23		0.002			215				3
128	Graph	5	x	ultrasonic method		23		0.003			220				3
128	Graph	5	x	ultrasonic method		23		0.010			215				3
128	Graph	5	x	ultrasonic method		23		0.026			208				3
128	Graph	5	x	ultrasonic method		23		0.027			211				3
128	Graph	5	x	ultrasonic method		23		0.028			196				3
128	Graph	5	x	ultrasonic method		23		0.038			203				3
128	Graph	5	x	ultrasonic method		23		0.042			202				3
128	Graph	5	x	ultrasonic method		23		0.061			189				3
128	Graph	5	x	ultrasonic method		23		0.083			178				3
128	Graph	5	x	ultrasonic method		23		0.101			160				3
128	Graph	5	x	ultrasonic method		23		0.116			157				3
128	Graph	5	x	ultrasonic method		23		0.120			157				3
128	Graph	5	x	ultrasonic method		23		0.120			134				3
129	Table	I	x	ultrasonic method		23	3.15				246				
130	Table	1	x	dynamic	1	23	3.05				202				
130	Graph	4	x	bending	1	23	3.05	0.037855			176				
130	Graph	4	x	bending	1	797					169				

$Al_6Si_2O_{13}$ { mullite, mullite(3:2), $3Al_2O_3 \cdot 2SiO_2$ }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
130	Graph	4	x	bending	1	984					153				
130	Graph	4	x	bending	1	1196					157				
130	Graph	4	x	bending	1	1294					142				
130	Graph	4	x	bending	1	1392					129				
130	Table	1	x	dynamic	2	23	3.01				195				
130	Graph	4	x	bending	2	23	3.01				174				
130	Graph	4	x	bending	2	796					158				
130	Graph	4	x	bending	2	994					143				
130	Graph	4	x	bending	2	1204					136				
130	Graph	4	x	bending	2	1292					130				
130	Graph	4	x	bending	2	1402					119				
131	Table	II	x	dynamic		23	3.01				195				
131	Graph	3	x	bending		20	3.01	0.050473			178				
131	Graph	3	x	bending		800					159				
131	Graph	3	x	bending		1000					144				
131	Graph	3	x	bending		1200					138				
131	Graph	3	x	bending		1300					129				
131	Graph	3	x	bending		1400					120				
132	Table	II	x	ult.pulse echo		22	3.156	0.004416			227.5	88.9	172.4	0.280	
132	Graph	2	x	ult.pulse echo		17					227.64	88.96	172.51	0.2802	
132	Graph	2	x	ult.pulse echo		12					227.78	89.01	172.61	0.2803	
132	Graph	2	x	ult.pulse echo		7					227.90	89.06	172.70	0.2805	
132	Graph	2	x	ult.pulse echo		2					228.03	89.11	172.80	0.2807	
132	Graph	2	x	ult.pulse echo		-3					228.17	89.16	172.91	0.2808	
132	Graph	2	x	ult.pulse echo		-8					228.30	89.21	173.01	0.2810	
132	Graph	2	x	ult.pulse echo		-13					228.43	89.26	173.11	0.2811	

Footnotes:

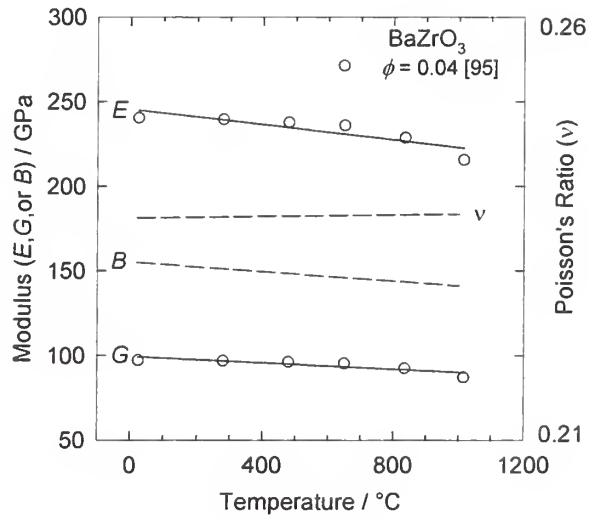
1: Mole fraction of Al_2O_3 = 60.1 % .

2: Mole fraction of Al_2O_3 = 62.8 % .

3: Apparent typographical error in unit corrected from 10^6 N/m^2 to GPa.

9.3 $BaZrO_3$ { barium zirconate }

M_r / (g mol^{-1}) = 276.549	Temperature range / (°C) = 0 to 1000	
ρ_{theo} / (g cm^{-3}) = 6.26	Porosity range = 0 to 0.04	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a

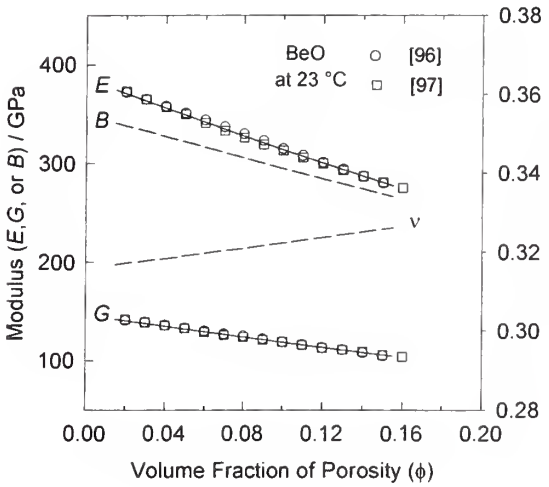


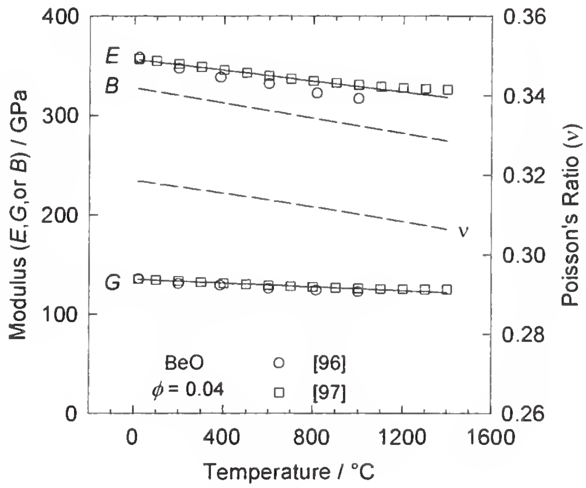
$BaZrO_3$ { barium zirconate }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
94	Table	1	x	Flex. res. (ASTM C1259)		23	6.09				229				
94	Table	1	x	Flex. res. (ASTM C1259)		23	6.12				220				
95	Table	2	x	ultrasonic velocity		25	6.01				240.5	97.2		0.237	
95	Table	2	x	ultrasonic velocity		280					239.5	96.9		0.236	
95	Table	2	x	ultrasonic velocity		480					237.7	96.2		0.235	
95	Table	2	x	ultrasonic velocity		650					235.9	95.4		0.236	
95	Table	2	x	ultrasonic velocity		835					228.6	92.4		0.237	
95	Table	2	x	ultrasonic velocity		1015					215.5	87.1		0.237	

9.4 BeO { beryllium oxide, beryllia }

M_r / (g mol^{-1}) = 25.012	Temperature range / (°C) = 0 to 1400	
ρ_{theo} / (g cm^{-3}) = 3.01	Porosity range = 0 to 0.16	
	E_o / (GPa) = 386	B_o / (GPa) = 350
	a / (10^{-4}°C) = 0.77	b / (10^{-4}°C) = 1.18
	n = 1.96	m = 1.61





BeO { beryllium oxide, beryllia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
96	Text	338	s	resonant vibration		23		0.02			372	141			
96	Text	338	s	resonant vibration		23		0.03			365	139			
96	Text	338	s	resonant vibration		23		0.04			358	136			
96	Text	338	s	resonant vibration		23		0.05			351	133			
96	Text	338	s	resonant vibration		23		0.06			344	130			
96	Text	338	s	resonant vibration		23		0.07			337	127			
96	Text	338	s	resonant vibration		23		0.08			330	125			
96	Text	338	s	resonant vibration		23		0.09			323	122			
96	Text	338	s	resonant vibration		23		0.10			315	119			
96	Text	338	s	resonant vibration		23		0.11			308	116			
96	Text	338	s	resonant vibration		23		0.12			301	113			
96	Text	338	s	resonant vibration		23		0.13			294	111			
96	Text	338	s	resonant vibration		23		0.14			287	108			
96	Text	338	s	resonant vibration		23		0.15			280	105			
96	Graph	9	x	resonant vibration		23		0.04			358.5	135.7		0.32	1
96	Graph	9	x	resonant vibration		200		0.04			347.5	130.7		0.33	1
96	Graph	9	x	resonant vibration		385		0.04			338.5	129.1		0.31	1
96	Graph	9	x	resonant vibration		600		0.04			332.3	125.8		0.32	1
96	Graph	9	x	resonant vibration		815		0.04			322.7	124.1		0.30	1
96	Graph	9	x	resonant vibration		1000		0.04			317.2	122.5		0.29	1
97	Table	IV	s	resonant vibration		20		0.02			373	142			2
97	Table	IV	s	resonant vibration		20		0.03			365	139			2
97	Table	IV	s	resonant vibration		20		0.04			357	136			2
97	Table	IV	s	resonant vibration		20		0.05			350	133			2
97	Table	IV	s	resonant vibration		20		0.06			341	129			2
97	Table	IV	s	resonant vibration		20		0.07			333	126			2
97	Table	IV	s	resonant vibration		20		0.08			326	124			2
97	Table	IV	s	resonant vibration		20		0.09			319	121			2
97	Table	IV	s	resonant vibration		20		0.10			313	119			2
97	Table	IV	s	resonant vibration		20		0.11			306	116			2
97	Table	IV	s	resonant vibration		20		0.12			300	113			2

BeO { beryllium oxide, beryllia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
97	Table	IV	s	resonant vibration		20		0.13			293	111			2
97	Table	IV	s	resonant vibration		20		0.14			287	109			2
97	Table	IV	s	resonant vibration		20		0.15			281	106			2
97	Table	IV	s	resonant vibration		20		0.16			275	104			2
97	Text	287	s	resonant vibration		100		0.02			371	140.8			3
97	Text	287	s	resonant vibration		200		0.02			367	139.5			3
97	Text	287	s	resonant vibration		300		0.02			364	138.3			3
97	Text	287	s	resonant vibration		400		0.02			361	137.2			3
97	Text	287	s	resonant vibration		500		0.02			358	136.0			3
97	Text	287	s	resonant vibration		600		0.02			355	135.0			3
97	Text	287	s	resonant vibration		700		0.02			352	134.0			3
97	Text	287	s	resonant vibration		800		0.02			350	133.2			3
97	Text	287	s	resonant vibration		900		0.02			347	132.4			3
97	Text	287	s	resonant vibration		1000		0.02			345	131.8			3
97	Text	287	s	resonant vibration		1100		0.02			344	131.3			3
97	Text	287	s	resonant vibration		1200		0.02			342	130.9			3
97	Text	287	s	resonant vibration		1300		0.02			341	130.7			3
97	Text	287	s	resonant vibration		1400		0.02			340	130.7			3

Footnotes:

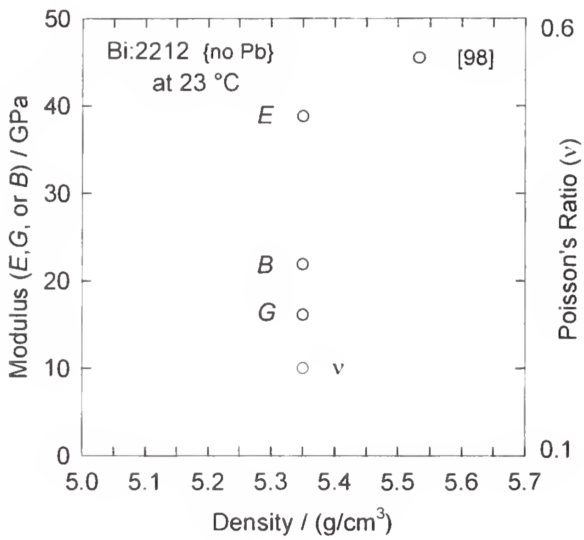
1: Values of Poisson's ratio were recalculated for consistency with E and G.

2: Hasselman's equation

3: Power law, 1-a(T-20)-b(T-20)^3

9.5 $Bi_2Sr_2CaCu_2O_{8+x}$ { Bi:2 212 }

M_r / (g mol^{-1}) = 888.366 + 15.9994x	Temperature range / (°C) = 27 to 27	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a

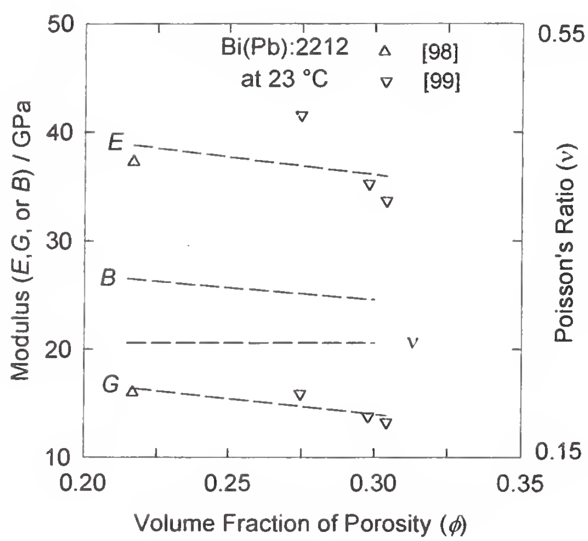


$Bi_2Sr_2CaCu_2O_{8+x}$ { Bi:2212 }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
98	Table	1	x	ultrasonic velocity		27	5.35		2.846	1.735	38.8	16.1	21.9	0.20	

9.6 $Bi_{2-x}Pb_xSr_2CaCu_2O_{8+y}$ { Bi(Pb):2212 }

M_r / (g mol^{-1}) = 888.366-1.78x+15.9994y	Temperature range / (°C) = -256 to 23
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a
	E_o / (GPa) = n/a B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a b / (10^{-4}°C) = n/a
	n = n/a m = n/a



$Bi_{2-x}Pb_xSr_2CaCu_2O_{8+y}$ { Bi(Pb):2212 }

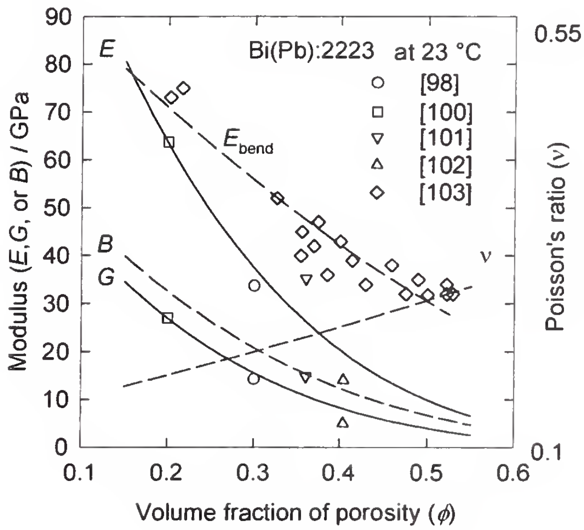
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
98	Table	1	x	ultrasonic velocity		27	5.02		2.821	1.784	37.30	16.00	18.60	0.1700	
98	Graph	3	x	ultrasonic velocity		-256					39.12	17.06	18.34	0.1508	
98	Graph	3	x	ultrasonic velocity		-238					39.08	17.06	18.32	0.1507	
98	Graph	3	x	ultrasonic velocity		-229					39.05	17.03	18.34	0.1510	
98	Graph	3	x	ultrasonic velocity		-221					39.02	17.00	18.35	0.1521	
98	Graph	3	x	ultrasonic velocity		-213					38.98	16.99	18.37	0.1524	
98	Graph	3	x	ultrasonic velocity		-204					38.94	16.96	18.37	0.1530	
98	Graph	3	x	ultrasonic velocity		-196					38.88	16.93	18.38	0.1539	
98	Graph	3	x	ultrasonic velocity		-187					38.84	16.90	18.38	0.1545	
98	Graph	3	x	ultrasonic velocity		-178					38.81	16.89	18.38	0.1543	
98	Graph	3	x	ultrasonic velocity		-170					38.74	16.86	18.38	0.1545	
98	Graph	3	x	ultrasonic velocity		-161					38.71	16.83	18.38	0.1548	
98	Graph	3	x	ultrasonic velocity		-153					38.68	16.82	18.36	0.1549	
98	Graph	3	x	ultrasonic velocity		-145					38.64	16.80	18.36	0.1551	
98	Graph	3	x	ultrasonic velocity		-135					38.64	16.79	18.35	0.1552	
98	Graph	3	x	ultrasonic velocity		-127					38.58	16.76	18.35	0.1553	
98	Graph	3	x	ultrasonic velocity		-117					38.51	16.74	18.36	0.1558	
98	Graph	3	x	ultrasonic velocity		-109					38.44	16.70	18.38	0.1575	
98	Graph	3	x	ultrasonic velocity		-101					38.37	16.66	18.43	0.1574	
98	Graph	3	x	ultrasonic velocity		-92					38.27	16.59	18.44	0.1595	
98	Graph	3	x	ultrasonic velocity		-83					38.24	16.56	18.51	0.1604	
98	Graph	3	x	ultrasonic velocity		-74					38.21	16.50	18.59	0.1619	
98	Graph	3	x	ultrasonic velocity		-67					38.01	16.40	18.56	0.1630	
98	Graph	3	x	ultrasonic velocity		-57					37.97	16.39	18.49	0.1630	
98	Graph	3	x	ultrasonic velocity		-49					37.90	16.36	18.47	0.1633	
98	Graph	3	x	ultrasonic velocity		-41					37.81	16.33	18.46	0.1634	
98	Graph	3	x	ultrasonic velocity		-31					37.74	16.30	18.44	0.1637	
98	Graph	3	x	ultrasonic velocity		-21					37.67	16.26	18.47	0.1643	
98	Graph	3	x	ultrasonic velocity		-14					37.61	16.22	18.52	0.1663	
98	Graph	3	x	ultrasonic velocity		-5					37.54	16.17	18.55	0.1672	
98	Graph	3	x	ultrasonic velocity		3					37.44	16.10	18.57	0.1687	
98	Graph	3	x	ultrasonic velocity		13					37.30	16.03	18.59	0.1691	

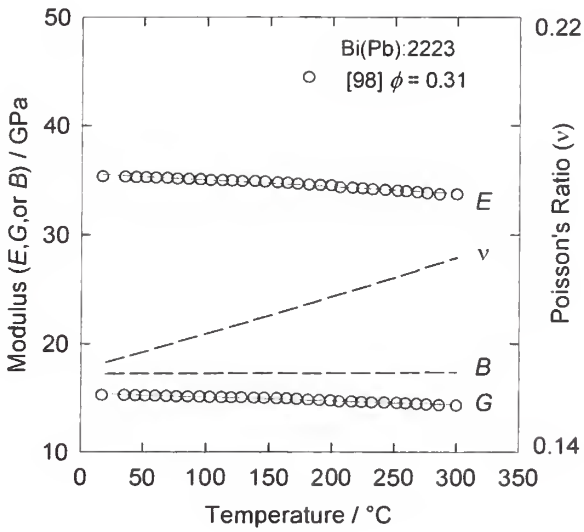
$Bi_{2-x}Pb_xSr_2CaCu_2O_{8+y}$ { Bi(Pb):2212 }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
99	Table	2	x	ultrasonic velocity		23	4.65		2.990	1.850	41.57	15.91		0.18	
99	Table	2	x	ultrasonic velocity		23	4.50		2.800	1.780	35.28	13.78		0.17	
99	Table	2	x	ultrasonic velocity		23	4.46		2.750	1.725	33.72	13.27		0.17	

9.7 $Bi_{2-x}Pb_xSr_2Ca_2Cu_3O_{10-y}$ { Bi(Pb):2223, BSCCO }

M_r / (g mol^{-1}) = 1023.989-1.78x-15.9994y	Temperature range / (°C) = -256 to 23
ρ_{theo} / (g cm^{-3}) = 6.3	Porosity range = n/a
	E_o / (GPa) = n/a B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a b / (10^{-4}°C) = n/a
	n = n/a m = n/a





$Bi_{2-x}Pb_xSr_2Ca_2Cu_3O_{10-y}$ { Bi(Pb):2223 }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
98	Table	2	x	ultrasonic velocity		27	4.35		2.894	1.813	33.7	14.3	17.4	0.18	1
98	Graph	3	x	ultrasonic velocity		-256					35.34	15.25	17.15	0.1596	1
98	Graph	3	x	ultrasonic velocity		-238					35.31	15.25	17.14	0.1596	1
98	Graph	3	x	ultrasonic velocity		-229					35.28	15.22	17.15	0.1599	1
98	Graph	3	x	ultrasonic velocity		-221					35.25	15.20	17.17	0.1610	1
98	Graph	3	x	ultrasonic velocity		-213					35.22	15.19	17.18	0.1614	1
98	Graph	3	x	ultrasonic velocity		-204					35.19	15.16	17.18	0.1620	1
98	Graph	3	x	ultrasonic velocity		-196					35.13	15.13	17.20	0.1629	1
98	Graph	3	x	ultrasonic velocity		-187					35.10	15.11	17.20	0.1636	1
98	Graph	3	x	ultrasonic velocity		-178					35.06	15.10	17.20	0.1634	1
98	Graph	3	x	ultrasonic velocity		-170					35.00	15.07	17.20	0.1636	1
98	Graph	3	x	ultrasonic velocity		-161					34.97	15.04	17.20	0.1639	1
98	Graph	3	x	ultrasonic velocity		-153					34.94	15.03	17.18	0.1640	1
98	Graph	3	x	ultrasonic velocity		-145					34.91	15.02	17.18	0.1642	1
98	Graph	3	x	ultrasonic velocity		-135					34.91	15.00	17.16	0.1643	1
98	Graph	3	x	ultrasonic velocity		-127					34.85	14.98	17.16	0.1645	1
98	Graph	3	x	ultrasonic velocity		-117					34.79	14.96	17.18	0.1650	1
98	Graph	3	x	ultrasonic velocity		-109					34.73	14.93	17.19	0.1667	1
98	Graph	3	x	ultrasonic velocity		-101					34.67	14.89	17.24	0.1667	1
98	Graph	3	x	ultrasonic velocity		-92					34.58	14.82	17.25	0.1689	1
98	Graph	3	x	ultrasonic velocity		-83					34.55	14.80	17.31	0.1699	1
98	Graph	3	x	ultrasonic velocity		-74					34.52	14.75	17.39	0.1715	1
98	Graph	3	x	ultrasonic velocity		-67					34.34	14.66	17.36	0.1726	1
98	Graph	3	x	ultrasonic velocity		-57					34.31	14.65	17.30	0.1726	1
98	Graph	3	x	ultrasonic velocity		-49					34.25	14.62	17.28	0.1729	1
98	Graph	3	x	ultrasonic velocity		-41					34.16	14.59	17.27	0.1731	1
98	Graph	3	x	ultrasonic velocity		-31					34.10	14.57	17.25	0.1734	1
98	Graph	3	x	ultrasonic velocity		-21					34.04	14.53	17.28	0.1740	1
98	Graph	3	x	ultrasonic velocity		-14					33.98	14.49	17.33	0.1761	1
98	Graph	3	x	ultrasonic velocity		-5					33.92	14.45	17.36	0.1770	1
98	Graph	3	x	ultrasonic velocity		3					33.82	14.39	17.37	0.1786	1
98	Graph	3	x	ultrasonic velocity		13					33.70	14.33	17.39	0.1791	1

$Bi_{2-x}Pb_xSr_2Ca_2Cu_3O_{10-y}$ { Bi(Pb):2223 }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
100	Table	2	x	ultrasonic velocity		23	4.989	0.0944	3.726	2.328	63.7	27.0	33.2	0.180	2
101	Table	5	x	ultrasonic velocity		23	3.998		3.000	1.950	35.26	14.89	15.15	0.13	2
102	Table	2	x	ultrasonic velocity		23	3.73	0.404	2.776	1.162	14.0	5.0			2
102	Graph	3	x	ultrasonic velocity		-178		0.404	3.10						2
102	Graph	3	x	ultrasonic velocity		-167		0.404	3.40						2
102	Graph	3	x	ultrasonic velocity		-160		0.404	3.70						2
102	Graph	3	x	ultrasonic velocity		-155		0.404	3.78						2
102	Graph	3	x	ultrasonic velocity		-149		0.404	3.89						2
102	Graph	3	x	ultrasonic velocity		-143		0.404	3.81						2
102	Graph	3	x	ultrasonic velocity		-139		0.404	3.40						2
102	Graph	3	x	ultrasonic velocity		-128		0.404	2.99						2
102	Graph	3	x	ultrasonic velocity		-106		0.404	2.58						2
102	Graph	3	x	ultrasonic velocity		-85		0.404	2.41						2
102	Graph	3	x	ultrasonic velocity		-65		0.404	2.30						2
102	Graph	3	x	ultrasonic velocity		-49		0.404	2.27						2
102	Graph	3	x	ultrasonic velocity		-32		0.404	2.32						2
102	Graph	3	x	ultrasonic velocity		-17		0.404	2.35						2
102	Graph	3	x	ultrasonic velocity		-2		0.404	2.40						2
102	Graph	3	x	ultrasonic velocity		7		0.404	2.54						2
102	Graph	3	x	ultrasonic velocity		14		0.404	2.62						2
102	Graph	3	x	ultrasonic velocity		26		0.404	2.73						2
103	Table	1	x	bending		23					31.84				
103	Graph	2	x	bending		23		0.202			73				
103	Graph	2	x	bending		23		0.216			75				
103	Graph	2	x	bending		23		0.326			52				
103	Graph	2	x	bending		23		0.355			45				
103	Graph	2	x	bending		23		0.354			40				
103	Graph	2	x	bending		23		0.369			42				
103	Graph	2	x	bending		23		0.374			47				

$Bi_{2-x}Pb_xSr_2Ca_2Cu_3O_{10-y}$ { Bi(Pb):2223 }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
103	Graph	2	x	bending		23		0.385			36				
103	Graph	2	x	bending		23		0.400			43				
103	Graph	2	x	bending		23		0.414			39				
103	Graph	2	x	bending		23		0.430			34				
103	Graph	2	x	bending		23		0.459			38				
103	Graph	2	x	bending		23		0.475			32				
103	Graph	2	x	bending		23		0.489			35				
103	Graph	2	x	bending		23		0.522			32				
103	Graph	2	x	bending		23		0.522			34				
103	Graph	2	x	bending		23		0.529			32				

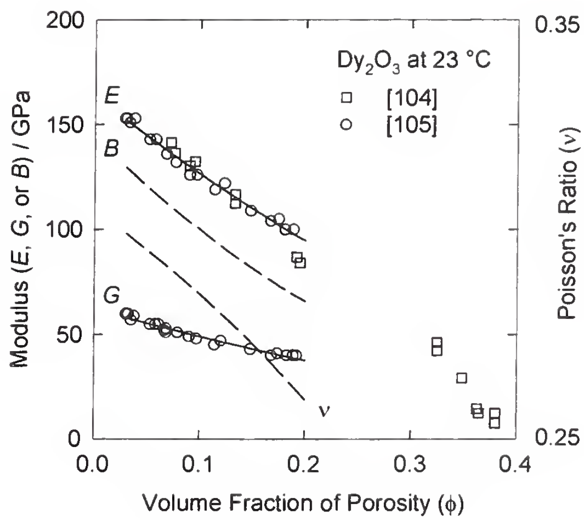
Footnotes:

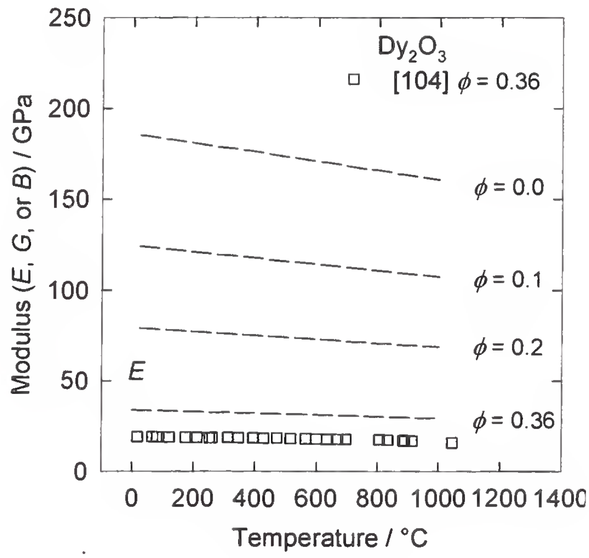
1: Values from the cited Table 2 were used to convert the relative values of the cited Graph 3 to absolute values.

2: $Bi_{1.7}Pb_{0.3}Sr_2Ca_2Cu_3O_{10-x}$

9.8 Dy_2O_3 { dysprosium oxide, dysprosia }

M_r / (g mol^{-1}) = 372.998	Temperature range / (°C) = 0 to 900	
ρ_{theo} / (g cm^{-3}) = 8.161	Porosity range = 0 to 0.2	
	E_o / (GPa) = 186	B_o / (GPa) = 144
	a / (10^{-4}°C) = 1.37	b / (10^{-4}°C) ={1.37}
	n = 381	m = 3.52





Dy_2O_3 { dysprosium oxide, dysprosia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
104	Graph	1	x	sonic resonance		23		0.072			141.4				
104	Graph	1	x	sonic resonance		23		0.076			136.5				
104	Graph	1	x	sonic resonance		23		0.095			132.4				
104	Graph	1	x	sonic resonance		23		0.09			130.3				
104	Graph	1	x	sonic resonance		23		0.133			116.5				
104	Graph	1	x	sonic resonance		23		0.133			112.4				
104	Graph	1	x	sonic resonance		23		0.192			86.9				
104	Graph	1	x	sonic resonance		23		0.195			84.1				
104	Graph	1	x	sonic resonance		23		0.325			46.2				
104	Graph	1	x	sonic resonance		23		0.325			42.1				
104	Graph	1	x	sonic resonance		23		0.349			29.0				
104	Graph	1	x	sonic resonance		23		0.363			14.5				
104	Graph	1	x	sonic resonance		23		0.365			12.4				
104	Graph	1	x	sonic resonance		23		0.38			12.4				
104	Graph	1	x	sonic resonance		23		0.38			7.6				
104	Graph	2	x	sonic resonance		17	5.192				19.1				
104	Graph	2	x	sonic resonance		66	5.192				19.1				
104	Graph	2	x	sonic resonance		80	5.192				19.1				
104	Graph	2	x	sonic resonance		120	5.192				19.0				
104	Graph	2	x	sonic resonance		174	5.192				18.9				
104	Graph	2	x	sonic resonance		212	5.192				18.8				
104	Graph	2	x	sonic resonance		261	5.192				18.7				
104	Graph	2	x	sonic resonance		252	5.192				18.6				
104	Graph	2	x	sonic resonance		311	5.192				18.6				
104	Graph	2	x	sonic resonance		345	5.192				18.5				
104	Graph	2	x	sonic resonance		394	5.192				18.4				
104	Graph	2	x	sonic resonance		428	5.192				18.3				
104	Graph	2	x	sonic resonance		472	5.192				18.2				
104	Graph	2	x	sonic resonance		516	5.192				18.1				
104	Graph	2	x	sonic resonance		565	5.192				18.0				
104	Graph	2	x	sonic resonance		599	5.192				17.9				
104	Graph	2	x	sonic resonance		633	5.192				17.8				

Dy_2O_3 { dysprosium oxide, dysprosia }

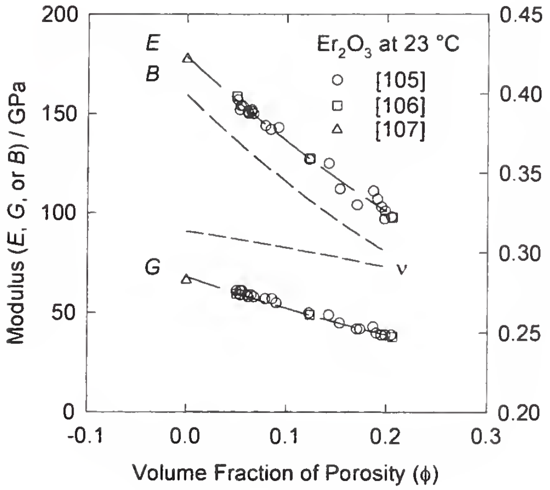
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
104	Graph	2	x	sonic resonance		669	5.192				17.7				
104	Graph	2	x	sonic resonance		697	5.192				17.7				
104	Graph	2	x	sonic resonance		806	5.192				17.5				
104	Graph	2	x	sonic resonance		834	5.192				17.4				
104	Graph	2	x	sonic resonance		884	5.192				17.1				
104	Graph	2	x	sonic resonance		884	5.192				17.0				
104	Graph	2	x	sonic resonance		889	5.192				16.9				
104	Graph	2	x	sonic resonance		913	5.192				16.8				
104	Graph	2	x	sonic resonance		1045	5.192				15.9				
105	Table	III	c	extrapolation		23		0			169.1	64.4	150.62	0.313	
105	Graph	2	x	sonic resonance		23		0.029			153				
105	Graph	2	x	sonic resonance		23		0.03			153				
105	Graph	2	x	sonic resonance		23		0.033			151				
105	Graph	2	x	sonic resonance		23		0.038			153				
105	Graph	2	x	sonic resonance		23		0.052			143				
105	Graph	2	x	sonic resonance		23		0.058			143				
105	Graph	2	x	sonic resonance		23		0.068			136				
105	Graph	2	x	sonic resonance		23		0.077			132				
105	Graph	2	x	sonic resonance		23		0.09			126				
105	Graph	2	x	sonic resonance		23		0.097			126				
105	Graph	2	x	sonic resonance		23		0.114			119				
105	Graph	2	x	sonic resonance		23		0.123			122				
105	Graph	2	x	sonic resonance		23		0.148			109				
105	Graph	2	x	sonic resonance		23		0.167			104				
105	Graph	2	x	sonic resonance		23		0.175			105				
105	Graph	2	x	sonic resonance		23		0.181			100				
105	Graph	2	x	sonic resonance		23		0.189			100				
105	Graph	2	x	sonic resonance		23		0.03				60			
105	Graph	2	x	sonic resonance		23		0.032				60			
105	Graph	2	x	sonic resonance		23		0.035				57			
105	Graph	2	x	sonic resonance		23		0.038				59			
105	Graph	2	x	sonic resonance		23		0.053				55			

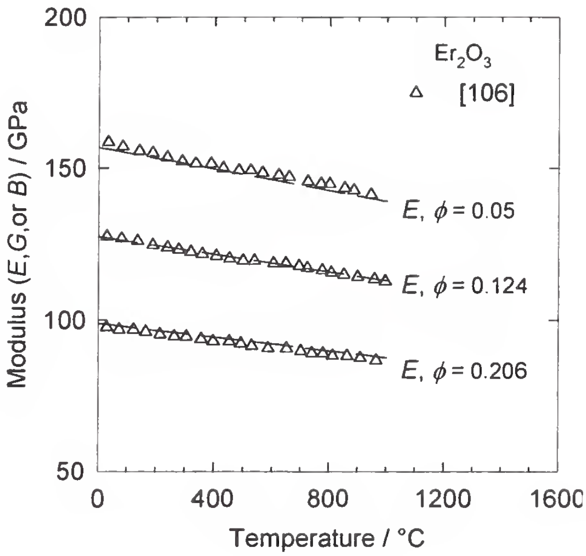
Dy_2O_3 { dysprosium oxide, dysprosia }

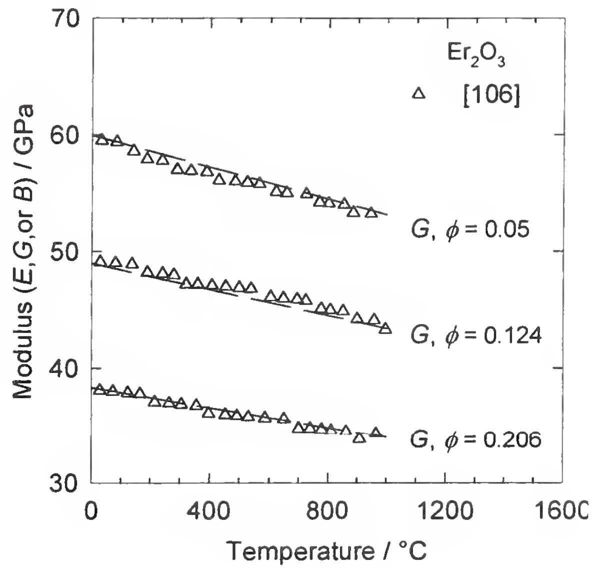
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
105	Graph	2	x	sonic resonance		23		0.058				55			
105	Graph	2	x	sonic resonance		23		0.061				55			
105	Graph	2	x	sonic resonance		23		0.067				52			
105	Graph	2	x	sonic resonance		23		0.068				53			
105	Graph	2	x	sonic resonance		23		0.068				51			
105	Graph	2	x	sonic resonance		23		0.079				51			
105	Graph	2	x	sonic resonance		23		0.09				49			
105	Graph	2	x	sonic resonance		23		0.097				48			
105	Graph	2	x	sonic resonance		23		0.114				45			
105	Graph	2	x	sonic resonance		23		0.12				47			
105	Graph	2	x	sonic resonance		23		0.148				43			
105	Graph	2	x	sonic resonance		23		0.168				40			
105	Graph	2	x	sonic resonance		23		0.174				41			
105	Graph	2	x	sonic resonance		23		0.183				40			
105	Graph	2	x	sonic resonance		23		0.189				40			
105	Graph	2	x	sonic resonance		23		0.192				40			

9.9 Er_2O_3 { erbium oxide, erbia }

M_r / (g mol^{-1}) = 382.516	Temperature range / (°C) = 0 to 1000	
ρ_{theo} / (g cm^{-3}) = 8.651	Porosity range = 0 to 0.2	
	E_o / (GPa) = 179	B_o / (GPa) = 160
	a / (10^{-4}°C) = 1.14	b / (10^{-4}°C) = 1.14
	n = 2.57	m = 3.08







Er_2O_3 { erbium oxide, erbia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
104	Graph	1	x	sonic resonance		23		0.088			149.6				
104	Graph	1	x	sonic resonance		23		0.088			145.5				
104	Graph	1	x	sonic resonance		23		0.183			113.1				
104	Graph	1	x	sonic resonance		23		0.178			109.0				
104	Graph	1	x	sonic resonance		23		0.176			104.8				
104	Graph	1	x	sonic resonance		23		0.185			103.4				
104	Graph	1	x	sonic resonance		23		0.183			100.0				
104	Graph	1	x	sonic resonance		23		0.216			88.3				
104	Graph	1	x	sonic resonance		23		0.216			86.2				
104	Graph	1	x	sonic resonance		23		0.256			84.8				
104	Graph	1	x	sonic resonance		23		0.259			68.3				
104	Graph	1	x	sonic resonance		23		0.282			64.1				
104	Graph	1	x	sonic resonance		23		0.282			59.3				
104	Graph	1	x	sonic resonance		23		0.308			51.7				
104	Graph	1	x	sonic resonance		23		0.309			37.9				
104	Graph	2	x	sonic resonance		110	5.825				42.2				
104	Graph	2	x	sonic resonance		144	5.825				42.2				
104	Graph	2	x	sonic resonance		184	5.825				41.9				
104	Graph	2	x	sonic resonance		267	5.825				41.4				
104	Graph	2	x	sonic resonance		305	5.825				41.3				
104	Graph	2	x	sonic resonance		321	5.825				41.2				
104	Graph	2	x	sonic resonance		379	5.825				40.9				
104	Graph	2	x	sonic resonance		418	5.825				40.7				
104	Graph	2	x	sonic resonance		433	5.825				40.7				
104	Graph	2	x	sonic resonance		590	5.825				40.0				
104	Graph	2	x	sonic resonance		653	5.825				39.8				
104	Graph	2	x	sonic resonance		756	5.825				39.2				
104	Graph	2	x	sonic resonance		790	5.825				39.0				
104	Graph	2	x	sonic resonance		830	5.825				38.9				
104	Graph	2	x	sonic resonance		908	5.825				38.5				
104	Graph	2	x	sonic resonance		957	5.825				38.2				
104	Graph	2	x	sonic resonance		1016	5.825				37.8				

Er_2O_3 { erbium oxide, erbia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
104	Graph	2	x	sonic resonance		1050	5.825				37.6				
104	Graph	2	x	sonic resonance		1080	5.825				37.5				
105	Table	III	c	extrapolation		23		0			175.21	67.78	140.72	0.292	
105	Graph	4	x	sonic resonance		23		0.051			157				
105	Graph	4	x	sonic resonance		23		0.053			152				
105	Graph	4	x	sonic resonance		23		0.054			154				
105	Graph	4	x	sonic resonance		23		0.056			154				
105	Graph	4	x	sonic resonance		23		0.062			150				
105	Graph	4	x	sonic resonance		23		0.061			151				
105	Graph	4	x	sonic resonance		23		0.065			151				
105	Graph	4	x	sonic resonance		23		0.065			152				
105	Graph	4	x	sonic resonance		23		0.067			150				
105	Graph	4	x	sonic resonance		23		0.079			144				
105	Graph	4	x	sonic resonance		23		0.084			142				
105	Graph	4	x	sonic resonance		23		0.092			143				
105	Graph	4	x	sonic resonance		23		0.123			127				
105	Graph	4	x	sonic resonance		23		0.143			125				
105	Graph	4	x	sonic resonance		23		0.154			112				
105	Graph	4	x	sonic resonance		23		0.171			104				
105	Graph	4	x	sonic resonance		23		0.187			111				
105	Graph	4	x	sonic resonance		23		0.191			107				
105	Graph	4	x	sonic resonance		23		0.195			103				
105	Graph	4	x	sonic resonance		23		0.198			97				
105	Graph	4	x	sonic resonance		23		0.199			101				
105	Graph	4	x	sonic resonance		23		0.205			98				
105	Graph	4	x	sonic resonance		23		0.05				61			
105	Graph	4	x	sonic resonance		23		0.054				59			
105	Graph	4	x	sonic resonance		23		0.054				61			
105	Graph	4	x	sonic resonance		23		0.056				61			
105	Graph	4	x	sonic resonance		23		0.061				59			
105	Graph	4	x	sonic resonance		23		0.062				58			
105	Graph	4	x	sonic resonance		23		0.065				59			

Er_2O_3 { erbium oxide, erbia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
105	Graph	4	x	sonic resonance		23		0.068				58			
105	Graph	4	x	sonic resonance		23		0.079				57			
105	Graph	4	x	sonic resonance		23		0.086				57			
105	Graph	4	x	sonic resonance		23		0.09				55			
105	Graph	4	x	sonic resonance		23		0.123				50			
105	Graph	4	x	sonic resonance		23		0.143				49			
105	Graph	4	x	sonic resonance		23		0.154				45			
105	Graph	4	x	sonic resonance		23		0.171				42			
105	Graph	4	x	sonic resonance		23		0.174				42			
105	Graph	4	x	sonic resonance		23		0.187				43			
105	Graph	4	x	sonic resonance		23		0.19				40			
105	Graph	4	x	sonic resonance		23		0.195				39			
105	Graph	4	x	sonic resonance		23		0.199				39			
105	Graph	4	x	sonic resonance		23		0.205				39			
106	Graph	3	x	sonic resonance		29		0.206			97.7	38.1			
106	Graph	3	x	sonic resonance		72		0.206			97.0	38.0			
106	Graph	3	x	sonic resonance		123		0.206			96.9	37.9			
106	Graph	3	x	sonic resonance		165		0.206			96.2	37.8			
106	Graph	3	x	sonic resonance		215		0.206			95.4	37.1			
106	Graph	3	x	sonic resonance		264		0.206			94.7	37.0			
106	Graph	3	x	sonic resonance		305		0.206			94.6	36.9			
106	Graph	3	x	sonic resonance		356		0.206			93.8	36.8			
106	Graph	3	x	sonic resonance		397		0.206			93.1	36.1			
106	Graph	3	x	sonic resonance		453		0.206			93.0	36.0			
106	Graph	3	x	sonic resonance		492		0.206			92.3	35.9			
106	Graph	3	x	sonic resonance		530		0.206			91.6	35.8			
106	Graph	3	x	sonic resonance		586		0.206			90.8	35.7			
106	Graph	3	x	sonic resonance		650		0.206			90.7	35.6			
106	Graph	3	x	sonic resonance		700		0.206			89.9	34.8			
106	Graph	3	x	sonic resonance		739		0.206			89.2	34.8			
106	Graph	3	x	sonic resonance		778		0.206			89.1	34.7			
106	Graph	3	x	sonic resonance		812		0.206			88.4	34.6			

Er_2O_3 { erbium oxide, erbia }

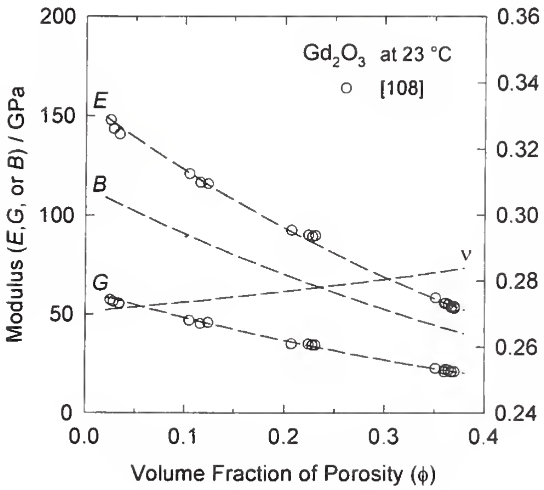
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
106	Graph	3	x	sonic resonance		863		0.206			88.3	34.5			
106	Graph	3	x	sonic resonance		909		0.206			87.6	33.8			
106	Graph	3	x	sonic resonance		965		0.206			86.8	34.3			
106	Graph	3	x	sonic resonance		29		0.124			127.5	49.1			
106	Graph	3	x	sonic resonance		80		0.124			126.8	49.0			
106	Graph	3	x	sonic resonance		136		0.124			126.0	48.9			
106	Graph	3	x	sonic resonance		189		0.124			124.6	48.2			
106	Graph	3	x	sonic resonance		240		0.124			123.9	48.1			
106	Graph	3	x	sonic resonance		279		0.124			123.2	48.0			
106	Graph	3	x	sonic resonance		320		0.124			122.4	47.2			
106	Graph	3	x	sonic resonance		359		0.124			121.7	47.2			
106	Graph	3	x	sonic resonance		407		0.124			121.0	47.1			
106	Graph	3	x	sonic resonance		453		0.124			120.2	47.0			
106	Graph	3	x	sonic resonance		499		0.124			119.5	46.9			
106	Graph	3	x	sonic resonance		538		0.124			119.4	46.8			
106	Graph	3	x	sonic resonance		604		0.124			118.6	46.1			
106	Graph	3	x	sonic resonance		647		0.124			118.6	46.0			
106	Graph	3	x	sonic resonance		693		0.124			117.8	45.9			
106	Graph	3	x	sonic resonance		722		0.124			117.1	45.8			
106	Graph	3	x	sonic resonance		775		0.124			116.4	45.1			
106	Graph	3	x	sonic resonance		807		0.124			115.6	45.0			
106	Graph	3	x	sonic resonance		851		0.124			114.9	44.9			
106	Graph	3	x	sonic resonance		899		0.124			114.2	44.2			
106	Graph	3	x	sonic resonance		958		0.124			113.4	44.1			
106	Graph	3	x	sonic resonance		996		0.124			112.7	43.3			
106	Graph	3	x	sonic resonance		32		0.05			158.6	59.5			
106	Graph	3	x	sonic resonance		83		0.05			157.2	59.4			
106	Graph	3	x	sonic resonance		141		0.05			155.8	58.6			
106	Graph	3	x	sonic resonance		187		0.05			155.1	57.9			
106	Graph	3	x	sonic resonance		238		0.05			153.7	57.8			
106	Graph	3	x	sonic resonance		289		0.05			152.3	57.0			
106	Graph	3	x	sonic resonance		335		0.05			151.6	56.9			
106	Graph	3	x	sonic resonance		388		0.05			151.5	56.8			

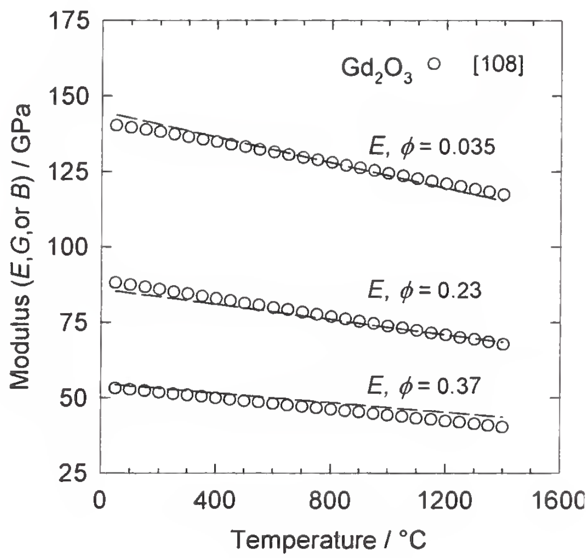
Er_2O_3 { erbium oxide, erbia }

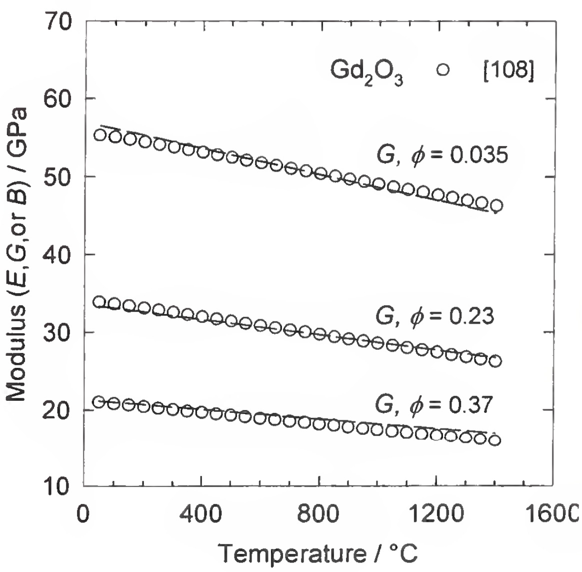
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
106	Graph	3	x	sonic resonance		429		0.05			150.1	56.1			
106	Graph	3	x	sonic resonance		483		0.05			149.3	56.0			
106	Graph	3	x	sonic resonance		524		0.05			149.3	55.9			
106	Graph	3	x	sonic resonance		565		0.05			148.5	55.8			
106	Graph	3	x	sonic resonance		621		0.05			147.8	55.1			
106	Graph	3	x	sonic resonance		657		0.05			147.1	55.0			
106	Graph	3	x	sonic resonance		723		0.05			145.6	54.9			
106	Graph	3	x	sonic resonance		769		0.05			144.9	54.2			
106	Graph	3	x	sonic resonance		800		0.05			144.8	54.1			
106	Graph	3	x	sonic resonance		853		0.05			143.4	54.0			
106	Graph	3	x	sonic resonance		885		0.05			142.7	53.3			
106	Graph	3	x	sonic resonance		945		0.05			141.3	53.2			
107	Table	II	x	sonic resonance		23		0			177.4	66.2	183.6	0.338	

9.10 Gd_2O_3 { gadolinium oxide, gadolinia }

M_r / (g mol^{-1}) = 362.498	Temperature range / (°C) = 0 to 1400	
ρ_{theo} / (g cm^{-3}) = 8.348	Porosity range = 0 to 0.37	
	E_o / (GPa) = 157	B_o / (GPa) = 114
	a / (10^{-4}°C) = 1.46	b / (10^{-4}°C) = 1.47
	n = 2.32	m = 2.19







Gd_2O_3 { gadolinium oxide, gadolinia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
108	Graph	1	x	sonic resonance		23		0.025			148.0	57.2		0.287	
108	Graph	1	x	sonic resonance		23		0.028			143.5	56.3		0.260	
108	Graph	1	x	sonic resonance		23		0.034			140.9	55.3		0.267	
108	Graph	1	x	sonic resonance		23		0.105			121.0	46.8		0.280	
108	Graph	1	x	sonic resonance		23		0.116			116.6	45.2		0.278	
108	Graph	1	x	sonic resonance		23		0.124			115.9	45.7		0.262	
108	Graph	1	x	sonic resonance		23		0.207			92.4	35.0		0.307	
108	Graph	1	x	sonic resonance		23		0.224			90.0	34.9		0.284	
108	Graph	1	x	sonic resonance		23		0.228			89.1	34.3		0.290	
108	Graph	1	x	sonic resonance		23		0.231			89.6	34.3		0.286	
108	Graph	1	x	sonic resonance		23		0.351			58.2	22.7		0.267	
108	Graph	1	x	sonic resonance		23		0.360			55.3	21.0		0.269	
108	Graph	1	x	sonic resonance		23		0.361			55.6	22.1		0.270	
108	Graph	1	x	sonic resonance		23		0.364			54.9	21.8		0.256	
108	Graph	1	x	sonic resonance		23		0.367			53.4	21.0		0.258	
108	Graph	1	x	sonic resonance		23		0.370			53.8	21.0		0.262	
108	Graph	1	x	sonic resonance		23		0.370			53.0	21.0		0.267	
108	Graph	3	x	sonic resonance		68		0.0347			140.6				
108	Graph	3	x	sonic resonance		110		0.0347			138.9				
108	Graph	3	x	sonic resonance		158		0.0347			138.7				
108	Graph	3	x	sonic resonance		201		0.0347			137.8				
108	Graph	3	x	sonic resonance		261		0.0347			136.8				
108	Graph	3	x	sonic resonance		328		0.0347			135.8				
108	Graph	3	x	sonic resonance		383		0.0347			134.9				
108	Graph	3	x	sonic resonance		461		0.0347			133.0				
108	Graph	3	x	sonic resonance		522		0.0347			132.8				
108	Graph	3	x	sonic resonance		583		0.0347			131.9				
108	Graph	3	x	sonic resonance		650		0.0347			130.9				
108	Graph	3	x	sonic resonance		710		0.0347			129.1				
108	Graph	3	x	sonic resonance		753		0.0347			128.9				
108	Graph	3	x	sonic resonance		826		0.0347			127.9				
108	Graph	3	x	sonic resonance		893		0.0347			126.9				

Gd_2O_3 { gadolinium oxide, gadolinia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
108	Graph	3	x	sonic resonance		910		0.0347			126.1				
108	Graph	3	x	sonic resonance		965		0.0347			125.1				
108	Graph	3	x	sonic resonance		1020		0.0347			124.9				
108	Graph	3	x	sonic resonance		1074		0.0347			123.2				
108	Graph	3	x	sonic resonance		1117		0.0347			122.2				
108	Graph	3	x	sonic resonance		1171		0.0347			122.1				
108	Graph	3	x	sonic resonance		1208		0.0347			121.2				
108	Graph	3	x	sonic resonance		1238		0.0347			120.3				
108	Graph	3	x	sonic resonance		1293		0.0347			120.1				
108	Graph	3	x	sonic resonance		1329		0.0347			118.4				
108	Graph	3	x	sonic resonance		1371		0.0347			117.5				
108	Graph	3	x	sonic resonance		67		0.2297			88.1				
108	Graph	3	x	sonic resonance		104		0.2297			87.2				
108	Graph	3	x	sonic resonance		158		0.2297			86.3				
108	Graph	3	x	sonic resonance		207		0.2297			85.3				
108	Graph	3	x	sonic resonance		261		0.2297			84.3				
108	Graph	3	x	sonic resonance		340		0.2297			82.5				
108	Graph	3	x	sonic resonance		395		0.2297			82.3				
108	Graph	3	x	sonic resonance		461		0.2297			81.3				
108	Graph	3	x	sonic resonance		528		0.2297			80.3				
108	Graph	3	x	sonic resonance		577		0.2297			79.4				
108	Graph	3	x	sonic resonance		650		0.2297			78.4				
108	Graph	3	x	sonic resonance		698		0.2297			78.2				
108	Graph	3	x	sonic resonance		741		0.2297			77.3				
108	Graph	3	x	sonic resonance		808		0.2297			76.3				
108	Graph	3	x	sonic resonance		856		0.2297			76.2				
108	Graph	3	x	sonic resonance		923		0.2297			75.2				
108	Graph	3	x	sonic resonance		972		0.2297			75.0				
108	Graph	3	x	sonic resonance		1014		0.2297			74.1				
108	Graph	3	x	sonic resonance		1063		0.2297			74.0				
108	Graph	3	x	sonic resonance		1112		0.2297			73.0				
108	Graph	3	x	sonic resonance		1148		0.2297			72.1				
108	Graph	3	x	sonic resonance		1190		0.2297			71.2				

Gd_2O_3 { gadolinium oxide, gadolinia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
108	Graph	3	x	sonic resonance		1227		0.2297			71.1				
108	Graph	3	x	sonic resonance		1270		0.2297			70.9				
108	Graph	3	x	sonic resonance		1324		0.2297			69.2				
108	Graph	3	x	sonic resonance		1361		0.2297			69.1				
108	Graph	3	x	sonic resonance		45		0.3660			52.7				
108	Graph	3	x	sonic resonance		81		0.3660			51.8				
108	Graph	3	x	sonic resonance		136		0.3660			51.6				
108	Graph	3	x	sonic resonance		172		0.3660			51.5				
108	Graph	3	x	sonic resonance		233		0.3660			51.3				
108	Graph	3	x	sonic resonance		312		0.3660			50.3				
108	Graph	3	x	sonic resonance		385		0.3660			49.3				
108	Graph	3	x	sonic resonance		452		0.3660			49.1				
108	Graph	3	x	sonic resonance		507		0.3660			48.9				
108	Graph	3	x	sonic resonance		568		0.3660			47.9				
108	Graph	3	x	sonic resonance		635		0.3660			46.9				
108	Graph	3	x	sonic resonance		690		0.3660			46.8				
108	Graph	3	x	sonic resonance		745		0.3660			46.6				
108	Graph	3	x	sonic resonance		799		0.3660			45.6				
108	Graph	3	x	sonic resonance		848		0.3660			45.5				
108	Graph	3	x	sonic resonance		903		0.3660			44.5				
108	Graph	3	x	sonic resonance		958		0.3660			44.4				
108	Graph	3	x	sonic resonance		1013		0.3660			44.2				
108	Graph	3	x	sonic resonance		1061		0.3660			43.3				
108	Graph	3	x	sonic resonance		1098		0.3660			43.2				
108	Graph	3	x	sonic resonance		1153		0.3660			43.0				
108	Graph	3	x	sonic resonance		1195		0.3660			42.1				
108	Graph	3	x	sonic resonance		1226		0.3660			42.0				
108	Graph	3	x	sonic resonance		1274		0.3660			41.9				
108	Graph	3	x	sonic resonance		1317		0.3660			40.9				
108	Graph	3	x	sonic resonance		1353		0.3660			40.0				
108	Graph	3	x	sonic resonance		51		0.0347				54.3			
108	Graph	3	x	sonic resonance		94		0.0347				54.1			
108	Graph	3	x	sonic resonance		143		0.0347				54.0			

Gd_2O_3 { gadolinium oxide, gadolinia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
108	Graph	3	x	sonic resonance		180		0.0347				53.9			
108	Graph	3	x	sonic resonance		253		0.0347				53.7			
108	Graph	3	x	sonic resonance		314		0.0347				53.5			
108	Graph	3	x	sonic resonance		387		0.0347				53.3			
108	Graph	3	x	sonic resonance		454		0.0347				52.3			
108	Graph	3	x	sonic resonance		515		0.0347				52.1			
108	Graph	3	x	sonic resonance		563		0.0347				51.2			
108	Graph	3	x	sonic resonance		643		0.0347				50.9			
108	Graph	3	x	sonic resonance		692		0.0347				50.8			
108	Graph	3	x	sonic resonance		747		0.0347				50.6			
108	Graph	3	x	sonic resonance		808		0.0347				50.5			
108	Graph	3	x	sonic resonance		881		0.0347				50.3			
108	Graph	3	x	sonic resonance		911		0.0347				49.4			
108	Graph	3	x	sonic resonance		960		0.0347				49.2			
108	Graph	3	x	sonic resonance		1009		0.0347				49.1			
108	Graph	3	x	sonic resonance		1064		0.0347				48.9			
108	Graph	3	x	sonic resonance		1106		0.0347				48.0			
108	Graph	3	x	sonic resonance		1167		0.0347				47.8			
108	Graph	3	x	sonic resonance		1198		0.0347				47.7			
108	Graph	3	x	sonic resonance		1234		0.0347				47.6			
108	Graph	3	x	sonic resonance		1283		0.0347				47.5			
108	Graph	3	x	sonic resonance		1320		0.0347				47.4			
108	Graph	3	x	sonic resonance		1362		0.0347				46.4			
108	Graph	3	x	sonic resonance		54		0.2297				33.3			
108	Graph	3	x	sonic resonance		90		0.2297				32.3			
108	Graph	3	x	sonic resonance		151		0.2297				32.2			
108	Graph	3	x	sonic resonance		194		0.2297				32.9			
108	Graph	3	x	sonic resonance		255		0.2297				31.9			
108	Graph	3	x	sonic resonance		328		0.2297				31.7			
108	Graph	3	x	sonic resonance		389		0.2297				31.5			
108	Graph	3	x	sonic resonance		450		0.2297				31.3			
108	Graph	3	x	sonic resonance		523		0.2297				30.3			
108	Graph	3	x	sonic resonance		566		0.2297				30.2			

Gd_2O_3 { gadolinium oxide, gadolinia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
108	Graph	3	x	sonic resonance		639		0.2297				30.0			
108	Graph	3	x	sonic resonance		688		0.2297				29.8			
108	Graph	3	x	sonic resonance		743		0.2297				29.7			
108	Graph	3	x	sonic resonance		798		0.2297				29.5			
108	Graph	3	x	sonic resonance		846		0.2297				28.6			
108	Graph	3	x	sonic resonance		914		0.2297				29.2			
108	Graph	3	x	sonic resonance		968		0.2297				28.2			
108	Graph	3	x	sonic resonance		1011		0.2297				28.1			
108	Graph	3	x	sonic resonance		1060		0.2297				27.9			
108	Graph	3	x	sonic resonance		1103		0.2297				27.8			
108	Graph	3	x	sonic resonance		1145		0.2297				27.7			
108	Graph	3	x	sonic resonance		1188		0.2297				27.6			
108	Graph	3	x	sonic resonance		1219		0.2297				27.5			
108	Graph	3	x	sonic resonance		1273		0.2297				26.5			
108	Graph	3	x	sonic resonance		1310		0.2297				26.4			
108	Graph	3	x	sonic resonance		1353		0.2297				26.3			
108	Graph	3	x	sonic resonance		42		0.3660				20.4			
108	Graph	3	x	sonic resonance		72		0.3660				20.3			
108	Graph	3	x	sonic resonance		133		0.3660				20.1			
108	Graph	3	x	sonic resonance		164		0.3660				20.0			
108	Graph	3	x	sonic resonance		231		0.3660				19.8			
108	Graph	3	x	sonic resonance		304		0.3660				19.6			
108	Graph	3	x	sonic resonance		383		0.3660				19.4			
108	Graph	3	x	sonic resonance		445		0.3660				19.2			
108	Graph	3	x	sonic resonance		512		0.3660				19.0			
108	Graph	3	x	sonic resonance		561		0.3660				18.9			
108	Graph	3	x	sonic resonance		634		0.3660				18.7			
108	Graph	3	x	sonic resonance		683		0.3660				18.5			
108	Graph	3	x	sonic resonance		744		0.3660				18.4			
108	Graph	3	x	sonic resonance		792		0.3660				17.4			
108	Graph	3	x	sonic resonance		847		0.3660				17.2			
108	Graph	3	x	sonic resonance		902		0.3660				17.9			
108	Graph	3	x	sonic resonance		957		0.3660				17.7			

Gd_2O_3 { gadolinium oxide, gadolinia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
108	Graph	3	x	sonic resonance		1012		0.3660				16.8			
108	Graph	3	x	sonic resonance		1055		0.3660				17.5			
108	Graph	3	x	sonic resonance		1098		0.3660				17.3			
108	Graph	3	x	sonic resonance		1147		0.3660				17.2			
108	Graph	3	x	sonic resonance		1177		0.3660				17.1			
108	Graph	3	x	sonic resonance		1219		0.3660				16.2			
108	Graph	3	x	sonic resonance		1269		0.3660				16.8			
108	Graph	3	x	sonic resonance		1311		0.3660				15.9			
108	Graph	3	x	sonic resonance		1354		0.3660				15.8			
108	Graph	3	x	sonic resonance		55		0.0347					100.3		
108	Graph	3	x	sonic resonance		110		0.0347					100.1		
108	Graph	3	x	sonic resonance		158		0.0347					99.2		
108	Graph	3	x	sonic resonance		195		0.0347					99.1		
108	Graph	3	x	sonic resonance		262		0.0347					98.9		
108	Graph	3	x	sonic resonance		323		0.0347					98.7		
108	Graph	3	x	sonic resonance		377		0.0347					96.9		
108	Graph	3	x	sonic resonance		456		0.0347					95.9		
108	Graph	3	x	sonic resonance		524		0.0347					96.5		
108	Graph	3	x	sonic resonance		578		0.0347					94.7		
108	Graph	3	x	sonic resonance		651		0.0347					93.7		
108	Graph	3	x	sonic resonance		705		0.0347					92.7		
108	Graph	3	x	sonic resonance		754		0.0347					92.6		
108	Graph	3	x	sonic resonance		815		0.0347					92.4		
108	Graph	3	x	sonic resonance		882		0.0347					91.4		
108	Graph	3	x	sonic resonance		912		0.0347					91.3		
108	Graph	3	x	sonic resonance		961		0.0347					90.4		
108	Graph	3	x	sonic resonance		1016		0.0347					89.4		
108	Graph	3	x	sonic resonance		1070		0.0347					88.5		
108	Graph	3	x	sonic resonance		1119		0.0347					88.3		
108	Graph	3	x	sonic resonance		1167		0.0347					87.4		
108	Graph	3	x	sonic resonance		1204		0.0347					87.3		
108	Graph	3	x	sonic resonance		1228		0.0347					86.4		
108	Graph	3	x	sonic resonance		1283		0.0347					86.2		

Gd_2O_3 { gadolinium oxide, gadolinia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
108	Graph	3	x	sonic resonance		1332		0.0347					86.1		
108	Graph	3	x	sonic resonance		1374		0.0347					85.2		
108	Graph	3	x	sonic resonance		65		0.2297					70.4		
108	Graph	3	x	sonic resonance		97		0.2297					74.3		
108	Graph	3	x	sonic resonance		164		0.2297					71.7		
108	Graph	3	x	sonic resonance		199		0.2297					68.4		
108	Graph	3	x	sonic resonance		260		0.2297					69.0		
108	Graph	3	x	sonic resonance		332		0.2297					66.4		
108	Graph	3	x	sonic resonance		392		0.2297					64.6		
108	Graph	3	x	sonic resonance		460		0.2297					65.2		
108	Graph	3	x	sonic resonance		527		0.2297					65.0		
108	Graph	3	x	sonic resonance		570		0.2297					64.9		
108	Graph	3	x	sonic resonance		649		0.2297					63.0		
108	Graph	3	x	sonic resonance		703		0.2297					62.1		
108	Graph	3	x	sonic resonance		740		0.2297					62.8		
108	Graph	3	x	sonic resonance		813		0.2297					60.9		
108	Graph	3	x	sonic resonance		849		0.2297					60.8		
108	Graph	3	x	sonic resonance		916		0.2297					59.8		
108	Graph	3	x	sonic resonance		965		0.2297					59.7		
108	Graph	3	x	sonic resonance		1013		0.2297					58.8		
108	Graph	3	x	sonic resonance		1068		0.2297					57.8		
108	Graph	3	x	sonic resonance		1105		0.2297					57.7		
108	Graph	3	x	sonic resonance		1147		0.2297					56.8		
108	Graph	3	x	sonic resonance		1190		0.2297					56.6		
108	Graph	3	x	sonic resonance		1220		0.2297					56.5		
108	Graph	3	x	sonic resonance		1269		0.2297					55.6		
108	Graph	3	x	sonic resonance		1317		0.2297					55.5		
108	Graph	3	x	sonic resonance		1360		0.2297					54.5		
108	Graph	3	x	sonic resonance		37		0.3660					37.3		
108	Graph	3	x	sonic resonance		74		0.3660					37.2		
108	Graph	3	x	sonic resonance		135		0.3660					36.3		
108	Graph	3	x	sonic resonance		171		0.3660					36.2		
108	Graph	3	x	sonic resonance		238		0.3660					36.0		

Gd_2O_3 { gadolinium oxide, gadolinia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
108	Graph	3	x	sonic resonance		306		0.3660					35.8		
108	Graph	3	x	sonic resonance		391		0.3660					35.5		
108	Graph	3	x	sonic resonance		452		0.3660					34.5		
108	Graph	3	x	sonic resonance		507		0.3660					34.4		
108	Graph	3	x	sonic resonance		567		0.3660					33.4		
108	Graph	3	x	sonic resonance		641		0.3660					33.2		
108	Graph	3	x	sonic resonance		690		0.3660					33.8		
108	Graph	3	x	sonic resonance		744		0.3660					32.9		
108	Graph	3	x	sonic resonance		800		0.3660					31.7		
108	Graph	3	x	sonic resonance		848		0.3660					31.8		
108	Graph	3	x	sonic resonance		903		0.3660					31.6		
108	Graph	3	x	sonic resonance		958		0.3660					31.5		
108	Graph	3	x	sonic resonance		1013		0.3660					31.3		
108	Graph	3	x	sonic resonance		1055		0.3660					31.2		
108	Graph	3	x	sonic resonance		1104		0.3660					30.2		
108	Graph	3	x	sonic resonance		1147		0.3660					30.1		
108	Graph	3	x	sonic resonance		1189		0.3660					30.0		
108	Graph	3	x	sonic resonance		1226		0.3660					29.9		
108	Graph	3	x	sonic resonance		1275		0.3660					29.7		
108	Graph	3	x	sonic resonance		1311		0.3660					29.6		
108	Graph	3	x	sonic resonance		1354		0.3660					29.5		
108	Graph	3	x	sonic resonance		41		0.0347						0.269	
108	Graph	3	x	sonic resonance		90		0.0347						0.268	
108	Graph	3	x	sonic resonance		138		0.0347						0.268	
108	Graph	3	x	sonic resonance		180		0.0347						0.266	
108	Graph	3	x	sonic resonance		254		0.0347						0.267	
108	Graph	3	x	sonic resonance		309		0.0347						0.268	
108	Graph	3	x	sonic resonance		382		0.0347						0.268	
108	Graph	3	x	sonic resonance		449		0.0347						0.267	
108	Graph	3	x	sonic resonance		516		0.0347						0.268	
108	Graph	3	x	sonic resonance		558		0.0347						0.268	
108	Graph	3	x	sonic resonance		637		0.0347						0.269	
108	Graph	3	x	sonic resonance		686		0.0347						0.269	

Gd_2O_3 { gadolinium oxide, gadolinia }

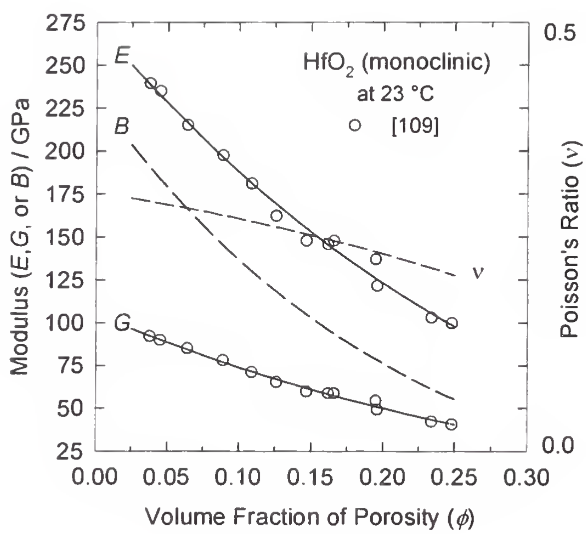
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
108	Graph	3	x	sonic resonance		741		0.0347						0.267	
108	Graph	3	x	sonic resonance		802		0.0347						0.268	
108	Graph	3	x	sonic resonance		875		0.0347						0.269	
108	Graph	3	x	sonic resonance		905		0.0347						0.269	
108	Graph	3	x	sonic resonance		948		0.0347						0.269	
108	Graph	3	x	sonic resonance		1008		0.0347						0.267	
108	Graph	3	x	sonic resonance		1051		0.0347						0.266	
108	Graph	3	x	sonic resonance		1106		0.0347						0.266	
108	Graph	3	x	sonic resonance		1160		0.0347						0.266	
108	Graph	3	x	sonic resonance		1191		0.0347						0.267	
108	Graph	3	x	sonic resonance		1228		0.0347						0.267	
108	Graph	3	x	sonic resonance		1276		0.0347						0.266	
108	Graph	3	x	sonic resonance		1313		0.0347						0.266	
108	Graph	3	x	sonic resonance		1355		0.0347						0.268	
108	Graph	3	x	sonic resonance		51		0.2297						0.292	
108	Graph	3	x	sonic resonance		96		0.2297						0.310	
108	Graph	3	x	sonic resonance		149		0.2297						0.301	
108	Graph	3	x	sonic resonance		197		0.2297						0.291	
108	Graph	3	x	sonic resonance		252		0.2297						0.294	
108	Graph	3	x	sonic resonance		324		0.2297						0.289	
108	Graph	3	x	sonic resonance		385		0.2297						0.287	
108	Graph	3	x	sonic resonance		452		0.2297						0.293	
108	Graph	3	x	sonic resonance		520		0.2297						0.294	
108	Graph	3	x	sonic resonance		568		0.2297						0.294	
108	Graph	3	x	sonic resonance		641		0.2297						0.292	
108	Graph	3	x	sonic resonance		690		0.2297						0.291	
108	Graph	3	x	sonic resonance		738		0.2297						0.293	
108	Graph	3	x	sonic resonance		799		0.2297						0.289	
108	Graph	3	x	sonic resonance		847		0.2297						0.289	
108	Graph	3	x	sonic resonance		915		0.2297						0.290	
108	Graph	3	x	sonic resonance		957		0.2297						0.289	
108	Graph	3	x	sonic resonance		1012		0.2297						0.289	
108	Graph	3	x	sonic resonance		1054		0.2297						0.289	

Gd_2O_3 { gadolinium oxide, gadolinia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
108	Graph	3	x	sonic resonance		1091		0.2297						0.289	
108	Graph	3	x	sonic resonance		1134		0.2297						0.290	
108	Graph	3	x	sonic resonance		1176		0.2297						0.291	
108	Graph	3	x	sonic resonance		1207		0.2297						0.291	
108	Graph	3	x	sonic resonance		1268		0.2297						0.291	
108	Graph	3	x	sonic resonance		1304		0.2297						0.290	
108	Graph	3	x	sonic resonance		1347		0.2297						0.292	
108	Graph	3	x	sonic resonance		40		0.3660						0.264	
108	Graph	3	x	sonic resonance		76		0.3660						0.262	
108	Graph	3	x	sonic resonance		131		0.3660						0.263	
108	Graph	3	x	sonic resonance		174		0.3660						0.264	
108	Graph	3	x	sonic resonance		235		0.3660						0.266	
108	Graph	3	x	sonic resonance		308		0.3660						0.263	
108	Graph	3	x	sonic resonance		387		0.3660						0.265	
108	Graph	3	x	sonic resonance		448		0.3660						0.264	
108	Graph	3	x	sonic resonance		509		0.3660						0.265	
108	Graph	3	x	sonic resonance		564		0.3660						0.265	
108	Graph	3	x	sonic resonance		637		0.3660						0.264	
108	Graph	3	x	sonic resonance		685		0.3660						0.264	
108	Graph	3	x	sonic resonance		740		0.3660						0.262	
108	Graph	3	x	sonic resonance		794		0.3660						0.260	
108	Graph	3	x	sonic resonance		844		0.3660						0.266	
108	Graph	3	x	sonic resonance		905		0.3660						0.264	
108	Graph	3	x	sonic resonance		953		0.3660						0.264	
108	Graph	3	x	sonic resonance		1008		0.3660						0.263	
108	Graph	3	x	sonic resonance		1050		0.3660						0.263	
108	Graph	3	x	sonic resonance		1099		0.3660						0.263	
108	Graph	3	x	sonic resonance		1142		0.3660						0.264	
108	Graph	3	x	sonic resonance		1178		0.3660						0.262	
108	Graph	3	x	sonic resonance		1225		0.3660						0.265	
108	Graph	3	x	sonic resonance		1270		0.3660						0.264	
108	Graph	3	x	sonic resonance		1300		0.3660						0.265	
108	Graph	3	x	sonic resonance		1349		0.3660						0.264	

9.11 HfO_2 (monoclinic) { hafnium dioxide, hafnia, HfO_2 (m), monoclinic hafnia }

M_r / (g mol^{-1}) = 210.489	Temperature range / (°C) = 23 to 23	
ρ_{theo} / (g cm^{-3}) = 10.113	Porosity range = 0 to 0.25	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a



HfO_2 (monoclinic) { hafnium oxide, hafnia, HfO_2(m), monoclinic hafnia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
109	Graph	1,2	x	sonic resonance		23		0.038			239.3	92.0	201.7	0.3019	1
109	Graph	1,2	x	sonic resonance		23		0.045			234.9	89.8	199.5	0.3029	1
109	Graph	1,2	x	sonic resonance		23		0.064			215.1	85.0	155.1	0.2674	1
109	Graph	1,2	x	sonic resonance		23		0.089			197.5	78.1	140.1	0.2636	1
109	Graph	1,2	x	sonic resonance		23		0.109			181.0	71.2	128.3	0.2662	1
109	Graph	1,2	x	sonic resonance		23		0.126			162.2	65.3	102.8	0.2392	1
109	Graph	1,2	x	sonic resonance		23		0.147			148.0	60.0	93.1	0.2348	1
109	Graph	1,2	x	sonic resonance		23		0.162			145.8	58.9	92.9	0.2390	1
109	Graph	1,2	x	sonic resonance		23		0.166			148.0	58.9	98.1	0.2469	1
109	Graph	1,2	x	sonic resonance		23		0.195			137.1	54.6	97.8	0.2653	1
109	Graph	1,2	x	sonic resonance		23		0.196			121.6	49.3	77.8	0.2378	1
109	Graph	1,2	x	sonic resonance		23		0.234			103.0	42.3	63.7	0.2303	1
109	Graph	1,2	x	sonic resonance		23		0.248			99.7	40.7	61.4	0.2271	1
109	Graph	1,2	x	sonic resonance		23		0.033			63.4	25.2			2
109	Graph	1,2	x	sonic resonance		23		0.077			72.5	31.0			2
109	Graph	1,2	x	sonic resonance		23		0.084			182.0	72.3			2
109	Graph	1,2	x	sonic resonance		23		0.086			121.2	50.0			2
109	Graph	1,2	x	sonic resonance		23		0.117			141.2	56.9			2
109	Graph	1,2	x	sonic resonance		23		0.136			91.5	37.2			2

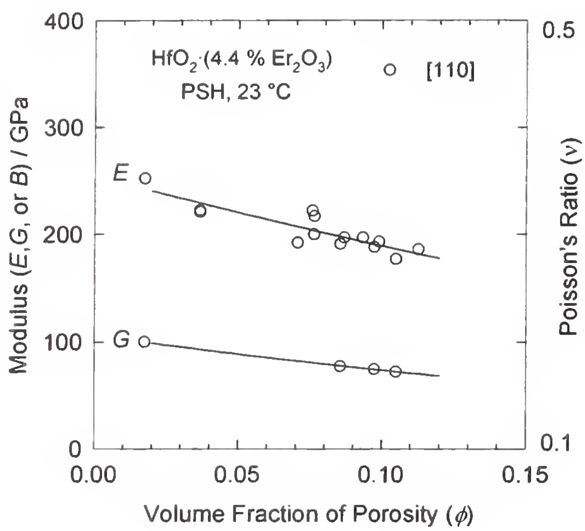
Footnotes:

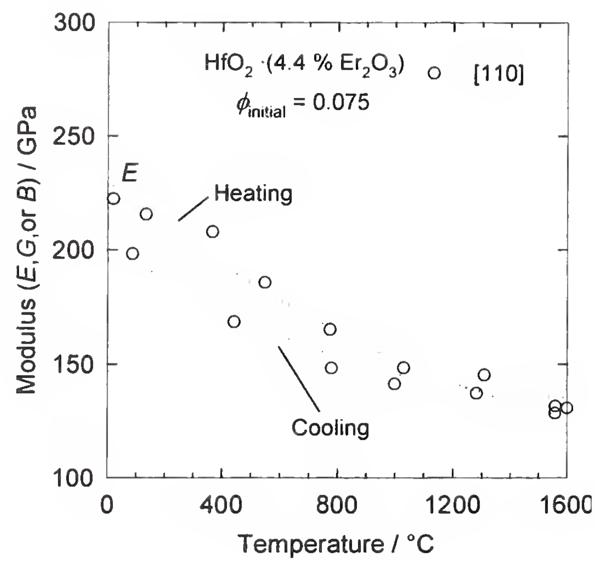
1: Specimens without microcracks

2: Specimens with microcracks

9.12 $HfO_2 \cdot xEr_2O_3$ (partially stabilized)   { hafnium dioxide, hafnia, Er-PSH, erbia partially stabilized hafnia }

M_r / (g mol^{-1}) = 210.489 + 382.516x	Temperature range / (°C) = 0 to 1600	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.12	
N.B.: {See also section 9.15 with all X-PSH data grouped together.}	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = na/	m = n/a





$HfO_2 \cdot xEr_2O_3$ (partially stabilized) { hafnium oxide, hafnia, Er-PSH, erbia partially stabilized hafnia }

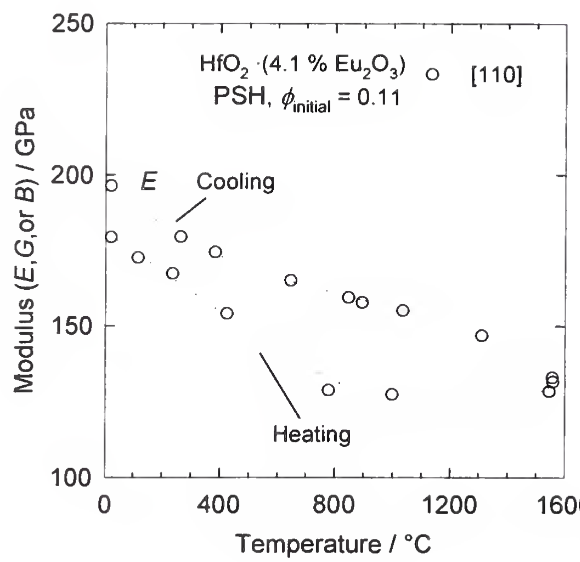
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
110	Graph	1	x	sonic resonance		23		0.0174			252	100.0			1
110	Graph	1	x	sonic resonance		23		0.0366			221				1
110	Graph	1	x	sonic resonance		23		0.0705			192				1
110	Graph	1	x	sonic resonance		23		0.0757			222				1
110	Graph	1	x	sonic resonance		23		0.0762			200				1
110	Graph	1	x	sonic resonance		23		0.0764			217				1
110	Graph	1	x	sonic resonance		23		0.0855			191	77.5			1
110	Graph	1	x	sonic resonance		23		0.0868			197				1
110	Graph	1	x	sonic resonance		23		0.0933			197				1
110	Graph	1	x	sonic resonance		23		0.0973			188	74.8			1
110	Graph	1	x	sonic resonance		23		0.0990			193				1
110	Graph	1	x	sonic resonance		23		0.1050			177	72.3			1
110	Graph	1	x	sonic resonance		23		0.1127			186				1
110	Graph	2	x	sonic resonance		19		0.0366			222.3				1,2
110	Graph	2	x	sonic resonance		132					215.6				1,2
110	Graph	2	x	sonic resonance		366					207.8				1,2
110	Graph	2	x	sonic resonance		549					185.7				1,2
110	Graph	2	x	sonic resonance		774					165.1				1,2
110	Graph	2	x	sonic resonance		999					141.4				1,2
110	Graph	2	x	sonic resonance		1281					137.3				1,2
110	Graph	2	x	sonic resonance		1557					128.5				1,2
110	Graph	2	x	sonic resonance		1558					131.7				1,2
110	Graph	2	x	sonic resonance		1600					130.8				1,3
110	Graph	2	x	sonic resonance		1307					145.2				1,3
110	Graph	2	x	sonic resonance		1030					148.4				1,3
110	Graph	2	x	sonic resonance		777					148.4				1,3
110	Graph	2	x	sonic resonance		442					168.5				1,3
110	Graph	2	x	sonic resonance		86					198.2				1,3

Footnotes:

1: Reported composition (mole fraction): 95.6 % HfO_2 + 4.4 % Er_2O_3 2: On heating   3: On cooling

9.13 $HfO_2 \cdot xEu_2O_3$ (partially stabilized) { hafnium dioxide, hafnia, Eu-PSH, europia partially stabilized hafnia }

M_r / (g mol^{-1}) = 210.489 + 351.926x	Temperature range / (°C) = 0 to 1600	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.12	
N.B.: {See also section 9.15 with all X-PSH data grouped together.}	E_o / (GPa) = n/a a / (10^{-4}°C) = n/a n = na/	B_o / (GPa) = n/a b / (10^{-4}°C) = n/a m = n/a



$HfO_2 \cdot xEu_2O_3$ (partially stabilized) { hafnium oxide, hafnia, Eu-PSH, europia partially stabilized hafnia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
110	Graph	1	x	sonic resonance		23		0.1095			175	70.0			1
110	Graph	1	x	sonic resonance		23		0.1351			172	70.9			1
110	Graph	2	x	sonic resonance		20		0.1095			179.4				1,2
110	Graph	2	x	sonic resonance		115					172.7				1,2
110	Graph	2	x	sonic resonance		234					167.5				1,2
110	Graph	2	x	sonic resonance		423					154.1				1,2
110	Graph	2	x	sonic resonance		778					128.8				1,2
110	Graph	2	x	sonic resonance		997					127.5				1,2
110	Graph	2	x	sonic resonance		1545					128.5				1,2
110	Graph	2	x	sonic resonance		1558					131.7				1,2
110	Graph	2	x	sonic resonance		1556					133.0				1,3
110	Graph	2	x	sonic resonance		1309					147.0				1,3
110	Graph	2	x	sonic resonance		1032					155.0				1,3
110	Graph	2	x	sonic resonance		893					157.7				1,3
110	Graph	2	x	sonic resonance		845					159.5				1,3
110	Graph	2	x	sonic resonance		645					165.0				1,3
110	Graph	2	x	sonic resonance		383					174.4				1,3
110	Graph	2	x	sonic resonance		263					179.6				1,3
110	Graph	2	x	sonic resonance		20					196.4				1,3

Footnotes:

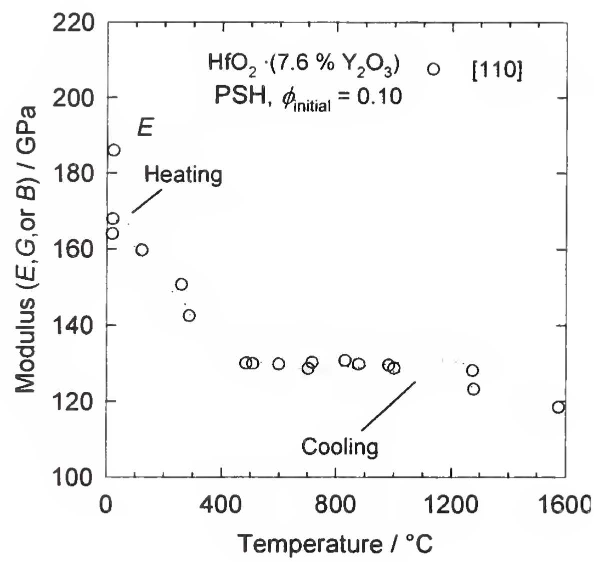
1: Reported composition (mole fraction): 95.9 % HfO_2 + 4.1 % Eu_2O_3

2: On heating

3: On cooling

9.14 $HfO_2 \cdot xY_2O_3$ (partially stabilized) { hafnium dioxide, hafnia, Y-PSH, yttria partially stabilized hafnia }

M_r / (g mol^{-1}) = 210.489 + 225.810x	Temperature range / (°C) = 0 to 1600	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.12	
N.B.: {See also section 9.15 with all X-PSH data grouped together.}	E_o / (GPa) = n/a a / (10^{-4}°C) = n/a n = na/	B_o / (GPa) = n/a b / (10^{-4}°C) = n/a m = n/a



$HfO_2 \cdot xY_2O_3$ (partially stabilized) { hafnium oxide, hafnia, Y-PSH, yttria partially stabilized hafnia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
110	Graph	1	x	sonic resonance		23		0.0779			204				1
110	Graph	1	x	sonic resonance		23		0.0904			189	75.1			1
110	Graph	1	x	sonic resonance		23		0.1013			186				1,2
110	Graph	2	x	sonic resonance		19					164.0				1,2
110	Graph	2	x	sonic resonance		122					159.7				1,2
110	Graph	2	x	sonic resonance		287					142.5				1,2
110	Graph	2	x	sonic resonance		484					130.0				1,2
110	Graph	2	x	sonic resonance		599					129.7				1,2
110	Graph	2	x	sonic resonance		702					128.6				1,2
110	Graph	2	x	sonic resonance		831					130.7				1,2
110	Graph	2	x	sonic resonance		982					129.5				1,2
110	Graph	2	x	sonic resonance		1274					128.0				1,2
110	Graph	2	x	sonic resonance		1575					118.5				1,2
110	Graph	2	x	sonic resonance		1610					112.0				1,2
110	Graph	2	x	sonic resonance		1279					123.2				1,3
110	Graph	2	x	sonic resonance		1000					128.7				1,3
110	Graph	2	x	sonic resonance		879					129.8				1,3
110	Graph	2	x	sonic resonance		715					130.2				1,3
110	Graph	2	x	sonic resonance		508					129.9				1,3
110	Graph	2	x	sonic resonance		259					150.6				1,3
110	Graph	2	x	sonic resonance		21					167.9				1,3

Footnotes:

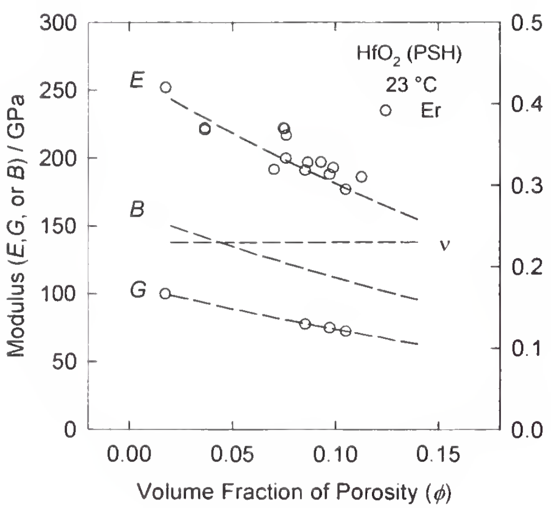
1: Reported composition (mole fraction): 92.3 % HfO_2 + 7.6 % Y_2O_3

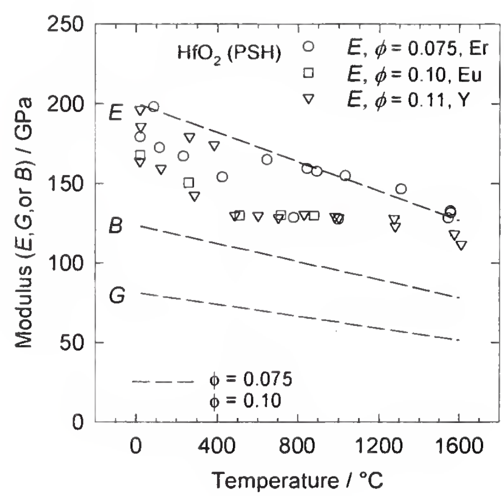
2: On heating

3: On cooling

9.15 $HfO_2 \cdot xX_2O_3$ (partially stabilized) { hafnium dioxide, hafnia, X-PSH, partially stabilized hafnia }

M_r / (g mol^{-1}) = 210.489 + $M_{X_2O_3}$x ρ_{theo} / (g cm^{-3}) = n/a	Temperature range / (°C) = 0 to 1600 Porosity range = 0 to 0.12	
N.B.: {All X-PSH data were grouped together to estimate the parameters}	E_o / (GPa) = {263} a / (10^{-4}°C) = {2.29} n = {3.47}	B_o / (GPa) = {162} b / (10^{-4}°C) = {2.29} m = {3.45}

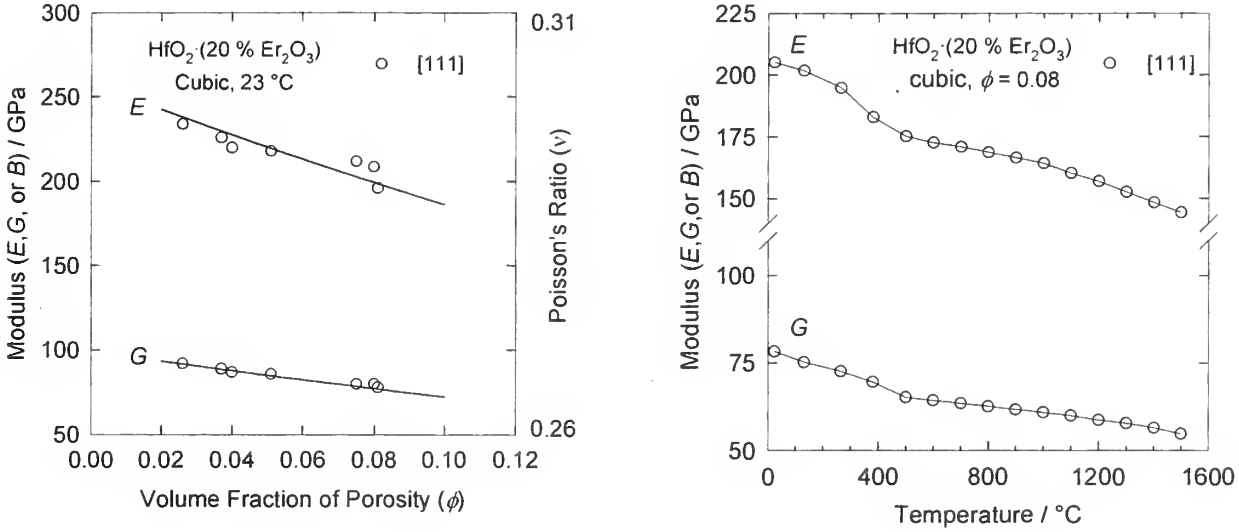




For data listings, see the separate listings for $HfO_2 \cdot xX_2O_3$ (partially stabilized), where X = Er, Eu, or Y.

9.16 $HfO_2 \cdot xEr_2O_3$ (cubic) { hafnium dioxide, hafnia, Er-HfO_2(c), erbia stabilized cubic hafnia }

M_r / (g mol^{-1}) = 210.489 + 382.516x	Temperature range / (°C) = 0 to 1500	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.08	
N.B.: {See also section 9.21 with all X-HfO_2(c) data grouped together.}	E_o / (GPa) = n/a a / (10^{-4}°C) = n/a n = na/	B_o / (GPa) = n/a b / (10^{-4}°C) = n/a m = n/a



$HfO_2 \cdot xEr_2O_3$ (cubic) { hafnium oxide, hafnia, Er-HfO2(c), erbia stabilized cubic hafnia }

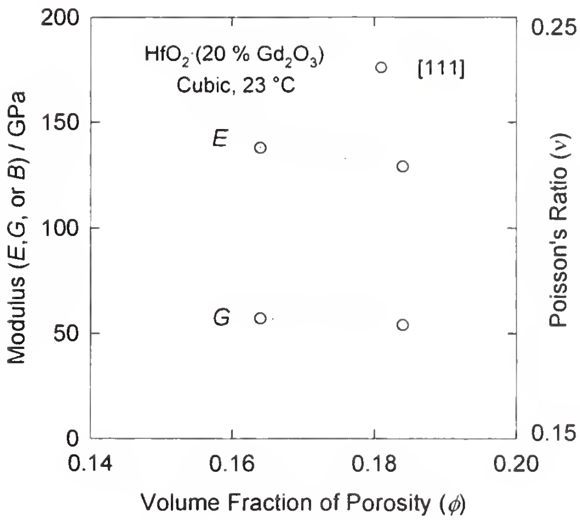
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
111	Graph	1	x	sonic resonance		23		0.026			234	92			1
111	Graph	1	x	sonic resonance		23		0.037			226	89			1
111	Graph	1	x	sonic resonance		23		0.040			220	87			1
111	Graph	1	x	sonic resonance		23		0.051			218	86			1
111	Graph	1	x	sonic resonance		23		0.075			212	80			1
111	Graph	1	x	sonic resonance		23		0.080			209	80			1
111	Graph	1	x	sonic resonance		23		0.081			196	78			1
111	Graph	1	x	sonic resonance		23		0.292			90	37			1
111	Graph	1	x	sonic resonance		23		0.365			54	24			1
111	Graph	3	x	sonic resonance		23		0.080			205.2	78.3			1
111	Graph	3	x	sonic resonance		130		0.080			201.7	75.2			1
111	Graph	3	x	sonic resonance		265		0.080			194.8	72.6			1
111	Graph	3	x	sonic resonance		380		0.080			183.0	69.6			1
111	Graph	3	x	sonic resonance		500		0.080			175.2	65.2			1
111	Graph	3	x	sonic resonance		600		0.080			172.6	64.3			1
111	Graph	3	x	sonic resonance		700		0.080			170.9	63.5			1
111	Graph	3	x	sonic resonance		800		0.080			168.7	62.6			1
111	Graph	3	x	sonic resonance		900		0.080			166.5	61.7			1
111	Graph	3	x	sonic resonance		1000		0.080			164.3	60.9			1
111	Graph	3	x	sonic resonance		1100		0.080			160.4	60.0			1
111	Graph	3	x	sonic resonance		1200		0.080			157.0	58.7			1
111	Graph	3	x	sonic resonance		1300		0.080			152.6	57.8			1
111	Graph	3	x	sonic resonance		1400		0.080			148.3	56.5			1
111	Graph	3	x	sonic resonance		1500		0.080			144.3	54.8			1

Footnotes:

1: Reported composition (mole fraction): 80 % HfO_2 + 20 % Er_2O_3

9.17 $HfO_2 \cdot xGd_2O_3$ (cubic) { hafnium dioxide, hafnia, Gd-HfO_2(c), gadolinia stabilized cubic hafnia }

M_r / (g mol^{-1}) = 210.489 + 362.498x	Temperature range / (°C) = 0 to 1500	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0.16 to 0.18	
N.B.: {See also section 9.21 with all X-HfO_2(c) data grouped together.}	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = na/	m = n/a



$HfO_2 \cdot xGd_2O_3$ (cubic) { hafnium oxide, hafnia, Gd-HfO2(c), gadolinia stabilized cubic hafnia }

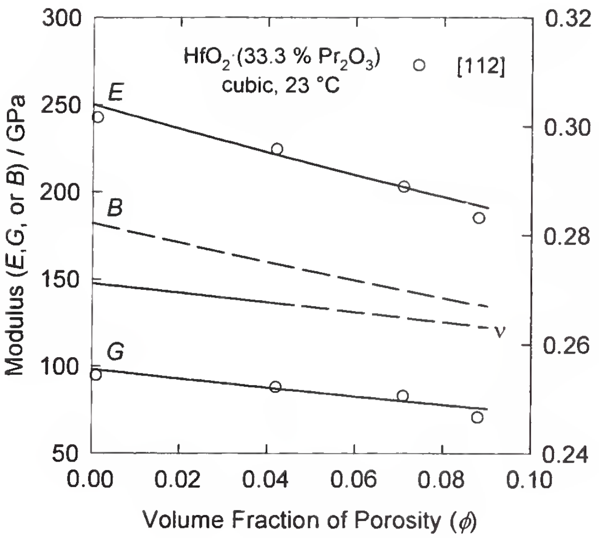
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
111	Graph	1	x	sonic resonance		23		0.164			138	57			1
111	Graph	1	x	sonic resonance		23		0.184			129	54			1

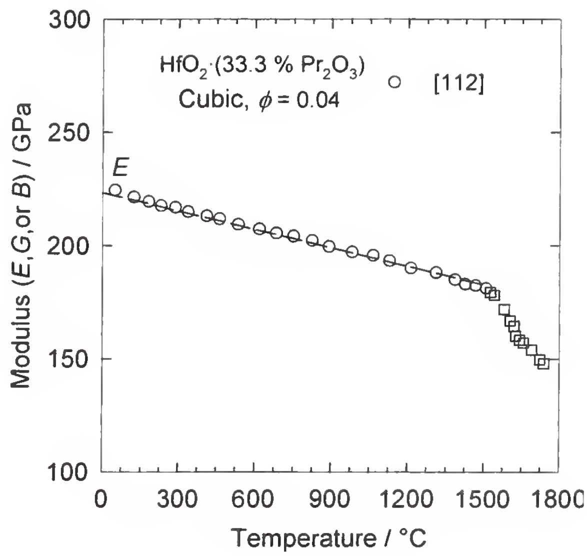
Footnotes:

1: Reported composition (mole fraction): 80 % HfO_2 + 20 % Gd_2O_3

9.18 $HfO_2 \cdot xPr_2O_3$ (cubic) { hafnium dioxide, hafnia, Pr-HfO_2(c), praseodymia stabilized cubic hafnia }

M_r / (g mol^{-1}) = 210.489 + 329.814x	Temperature range / (°C) = 0 to 1500	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.09	
	E_o / (GPa) = 251	B_o / (GPa) = 183
	a / (10^{-4}°C) = 1.21	b / (10^{-4}°C) = {1.21}
	n = 2.86	m = 3.23





$HfO_2 \cdot xPr_2O_3$ (cubic) { hafnium oxide, hafnia, Pr-HfO_2(c), praseodymia stabilized cubic hafnia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
112	Graph	1	x	sonic resonance		23		0.001			242.7	94.8			1
112	Graph	1	x	sonic resonance		23		0.042			224.4	88.1			1
112	Graph	1	x	sonic resonance		23		0.071			202.9	82.9			1
112	Graph	1	x	sonic resonance		23		0.088			185.1	70.9			1
112	Graph	2	x	sonic resonance		48		0.042			224.4				1
112	Graph	2	x	sonic resonance		122		0.042			221.3				1
112	Graph	2	x	sonic resonance		180		0.042			219.4				1
112	Graph	2	x	sonic resonance		229		0.042			217.5				1
112	Graph	2	x	sonic resonance		287		0.042			216.8				1
112	Graph	2	x	sonic resonance		337		0.042			214.9				1
112	Graph	2	x	sonic resonance		411		0.042			213.0				1
112	Graph	2	x	sonic resonance		461		0.042			211.7				1
112	Graph	2	x	sonic resonance		535		0.042			209.2				1
112	Graph	2	x	sonic resonance		617		0.042			207.3				1
112	Graph	2	x	sonic resonance		683		0.042			205.4				1
112	Graph	2	x	sonic resonance		750		0.042			204.1				1
112	Graph	2	x	sonic resonance		824		0.042			202.2				1
112	Graph	2	x	sonic resonance		890		0.042			199.6				1
112	Graph	2	x	sonic resonance		981		0.042			197.1				1
112	Graph	2	x	sonic resonance		1064		0.042			195.8				1
112	Graph	2	x	sonic resonance		1129		0.042			193.3				1
112	Graph	2	x	sonic resonance		1212		0.042			190.1				1
112	Graph	2	x	sonic resonance		1311		0.042			188.2				1
112	Graph	2	x	sonic resonance		1385		0.042			185.0				1
112	Graph	2	x	sonic resonance		1426		0.042			183.1				1
112	Graph	2	x	sonic resonance		1467		0.042			182.5				1
112	Graph	2	x	sonic resonance		1509		0.042			181.2				1
112	Graph	2	x	sonic resonance		1525		0.042			179.4				1
112	Graph	2	x	sonic resonance		1541		0.042			178.1				1
112	Graph	2	x	sonic resonance		1581		0.042			171.9				1
112	Graph	2	x	sonic resonance		1604		0.042			167.0				1
112	Graph	2	x	sonic resonance		1620		0.042			164.5				1

$HfO_2 \cdot xPr_2O_3$ (cubic) { hafnium oxide, hafnia, Pr-HfO_2(c), praseodymia stabilized cubic hafnia }

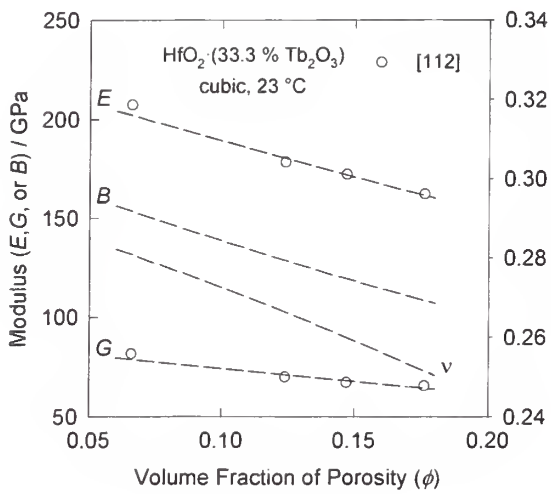
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
112	Graph	2	x	sonic resonance		1627		0.042			160.2				1
112	Graph	2	x	sonic resonance		1643		0.042			158.4				1
112	Graph	2	x	sonic resonance		1659		0.042			157.1				1
112	Graph	2	x	sonic resonance		1691		0.042			154.0				1
112	Graph	2	x	sonic resonance		1723		0.042			149.7				1
112	Graph	2	x	sonic resonance		1739		0.042			147.9				1

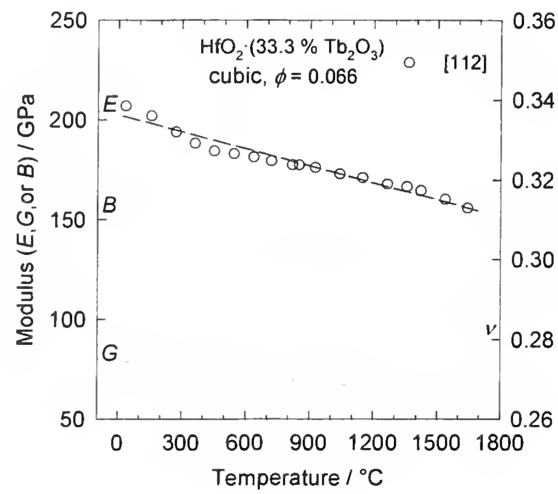
Footnotes:

1: Reported composition (mole fraction): 66.7 % HfO_2 + 33.3 % Pr_2O_3

9.19 $HfO_2 \cdot xTb_2O_3$ (cubic) { hafnium dioxide, hafnia, Tb-HfO_2(c), terbia stabilized cubic hafnia }

M_r / (g mol^{-1}) = 210.489 + 365.849x	Temperature range / (°C) = 0 to 1650	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.18	
	E_o / (GPa) = 229	B_o / (GPa) = 186
	a / (10^{-4}°C) = 1.41	b / (10^{-4}°C) = {1.41}
	n = 1.78	m = 2.78





$HfO_2 \cdot xTb_2O_3$ **{ hafnium oxide, hafnia, Tb-HfO2(c), terbia stabilized cubic hafnia }**

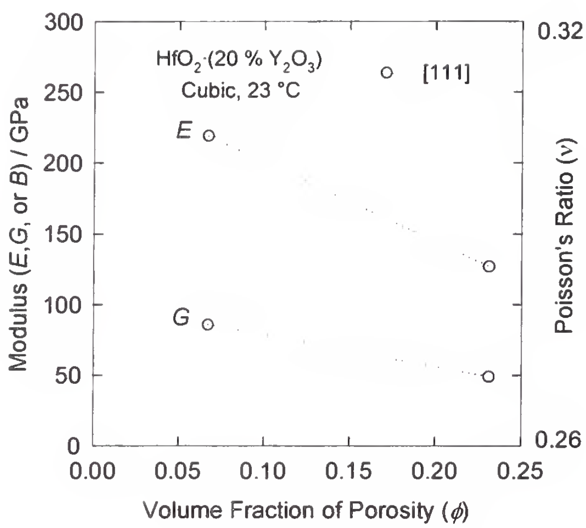
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
112	Graph	1	x	sonic resonance		23		0.066			207.6	81.8			1
112	Graph	1	x	sonic resonance		23		0.124			178.5	70.2			1
112	Graph	1	x	sonic resonance		23		0.147			172.3	67.4			1
112	Graph	1	x	sonic resonance		23		0.176			162.4	65.7			1
112	Graph	2	x	sonic resonance		34		0.066			207.3				1
112	Graph	2	x	sonic resonance		157		0.066			202.2				1
112	Graph	2	x	sonic resonance		271		0.066			194.1				1
112	Graph	2	x	sonic resonance		361		0.066			188.5				1
112	Graph	2	x	sonic resonance		452		0.066			184.8				1
112	Graph	2	x	sonic resonance		543		0.066			183.4				1
112	Graph	2	x	sonic resonance		634		0.066			181.5				1
112	Graph	2	x	sonic resonance		717		0.066			179.6				1
112	Graph	2	x	sonic resonance		816		0.066			177.6				1
112	Graph	2	x	sonic resonance		849		0.066			177.6				1
112	Graph	2	x	sonic resonance		924		0.066			176.3				1
112	Graph	2	x	sonic resonance		1039		0.066			173.1				1
112	Graph	2	x	sonic resonance		1147		0.066			171.2				1
112	Graph	2	x	sonic resonance		1263		0.066			168.0				1
112	Graph	2	x	sonic resonance		1354		0.066			166.7				1
112	Graph	2	x	sonic resonance		1420		0.066			164.7				1
112	Graph	2	x	sonic resonance		1535		0.066			160.3				1
112	Graph	2	x	sonic resonance		1642		0.066			155.9				1

Footnotes:

1: Reported composition (mole fraction): 66.7 % HfO_2 + 33.3 % Tb_2O_3

9.20 $HfO_2 \cdot xY_2O_3$ (cubic) { hafnium dioxide, hafnia, Y-HfO_2(c), yttria stabilized cubic hafnia }

M_r / (g mol^{-1}) = 210.489 + 225.810x	Temperature range / (°C) = 0 to 1500	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.38	
N.B.: {See also section 9.21 with all X-HfO_2(c) data grouped together.}	E_o / (GPa) = n/a a / (10^{-4}°C) = n/a n = na/	B_o / (GPa) = n/a b / (10^{-4}°C) = n/a m = n/a



$HfO_2 \cdot xY_2O_3$ { hafnium oxide, hafnia, Y-HfO_2(c), yttria stabilized cubic hafnia }

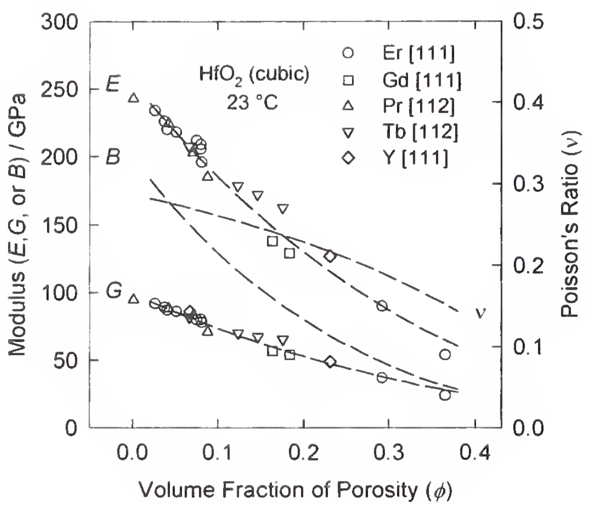
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
111	Graph	1	x	sonic resonance		23		0.067			219	86			1
111	Graph	1	x	sonic resonance		23		0.231			127	49			1

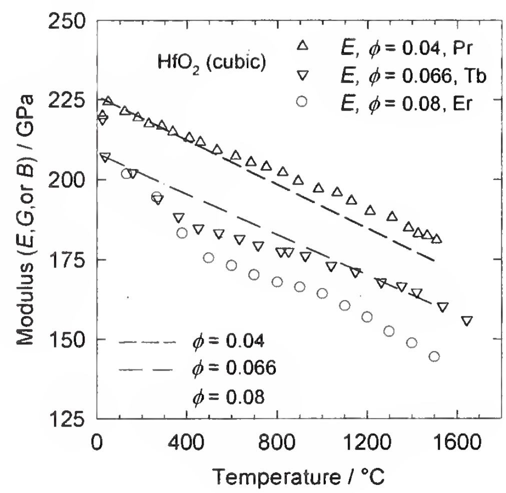
Footnotes:

1: Reported composition (mole fraction): 80 % HfO_2 + 20 % Y_2O_3

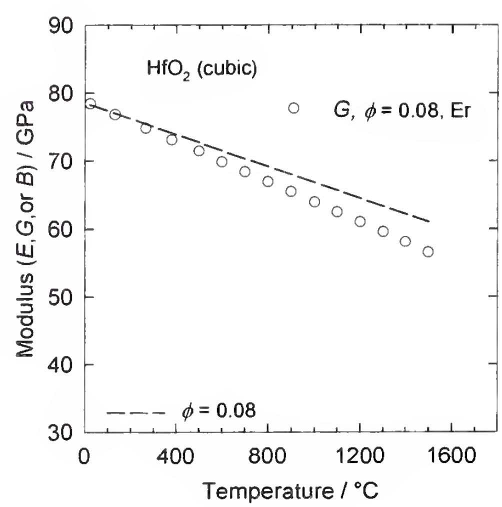
9.21 $HfO_2 \cdot xX_2O_3$ (cubic) { hafnium dioxide, hafnia, X-HfO_2(c), X stabilized cubic hafnia }

M_r / (g mol^{-1}) = 210.489 + M_xx ρ_{theo} / (g cm^{-3}) = n/a	Temperature range / (°C) = 0 to 1500 Porosity range = 0 to 0.38	
N.B.: {All X-HfO_2(c) data were grouped together to estimate the parameters}	E_o / (GPa) = {256} a / (10^{-4}°C) = {1.52} n = {3.01}	B_o / (GPa) = {200} b / (10^{-4}°C) = {1.70} m = {4.09}



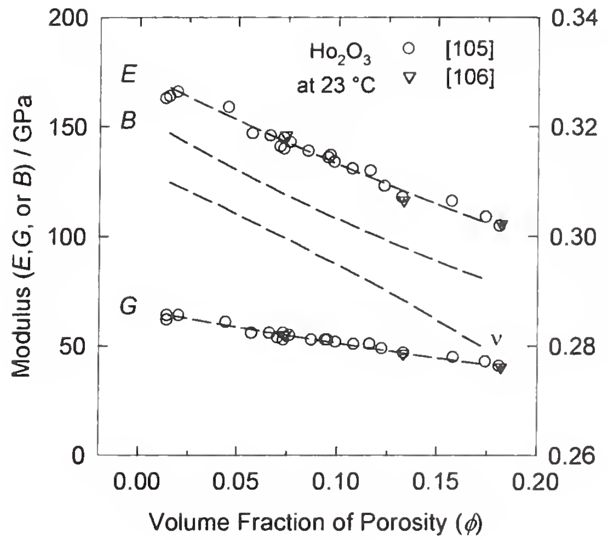


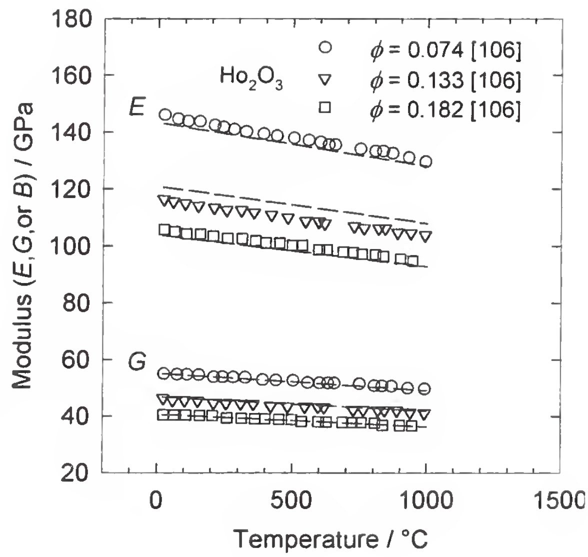
For data listings, see the separate listings for $HfO_2 \cdot xX_2O_3$ (cubic), where X = Er, Gd, Pr, Tb, or Y.



9.22 Ho_2O_3 { holmium oxide, holmia }

M_r / (g mol^{-1}) = 377.859	Temperature range / (°C) = 0 to 1000	
ρ_{theo} / (g cm^{-3}) = 8.414	Porosity range = 0 to 0.18	
	E_o / (GPa) = 175	B_o / (GPa) = 155
	a / (10^{-4}°C) = 1.08	b / (10^{-4}°C) = 0.98
	n = 2.60	m = 3.43





Ho_2O_3 { holmium oxide, holmia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
105	Table	III	c	extrapolation		23		0			169.4	65.54	134.68	0.290	
105	Graph	3	x	sonic resonance		23		0.013			163				
105	Graph	3	x	sonic resonance		23		0.015			164				
105	Graph	3	x	sonic resonance		23		0.019			166				
105	Graph	3	x	sonic resonance		23		0.045			159				
105	Graph	3	x	sonic resonance		23		0.057			147				
105	Graph	3	x	sonic resonance		23		0.066			146				
105	Graph	3	x	sonic resonance		23		0.071			141				
105	Graph	3	x	sonic resonance		23		0.073			140				
105	Graph	3	x	sonic resonance		23		0.073			145				
105	Graph	3	x	sonic resonance		23		0.076			143				
105	Graph	3	x	sonic resonance		23		0.085			139				
105	Graph	3	x	sonic resonance		23		0.095			136				
105	Graph	3	x	sonic resonance		23		0.096			137				
105	Graph	3	x	sonic resonance		23		0.098			134				
105	Graph	3	x	sonic resonance		23		0.107			131				
105	Graph	3	x	sonic resonance		23		0.116			130				
105	Graph	3	x	sonic resonance		23		0.123			123				
105	Graph	3	x	sonic resonance		23		0.132			118				
105	Graph	3	x	sonic resonance		23		0.157			116				
105	Graph	3	x	sonic resonance		23		0.174			109				
105	Graph	3	x	sonic resonance		23		0.181			105				
105	Graph	3	x	sonic resonance		23		0.014				64			
105	Graph	3	x	sonic resonance		23		0.014				62			
105	Graph	3	x	sonic resonance		23		0.02				64			
105	Graph	3	x	sonic resonance		23		0.044				61			
105	Graph	3	x	sonic resonance		23		0.057				56			
105	Graph	3	x	sonic resonance		23		0.066				56			
105	Graph	3	x	sonic resonance		23		0.07				54			
105	Graph	3	x	sonic resonance		23		0.073				56			
105	Graph	3	x	sonic resonance		23		0.073				53			
105	Graph	3	x	sonic resonance		23		0.076				55			

Ho_2O_3 { holmium oxide, holmia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
105	Graph	3	x	sonic resonance		23		0.087				53			
105	Graph	3	x	sonic resonance		23		0.094				53			
105	Graph	3	x	sonic resonance		23		0.095				53			
105	Graph	3	x	sonic resonance		23		0.099				52			
105	Graph	3	x	sonic resonance		23		0.108				51			
105	Graph	3	x	sonic resonance		23		0.116				51			
105	Graph	3	x	sonic resonance		23		0.122				49			
105	Graph	3	x	sonic resonance		23		0.133				47			
105	Graph	3	x	sonic resonance		23		0.158				45			
105	Graph	3	x	sonic resonance		23		0.174				43			
105	Graph	3	x	sonic resonance		23		0.181				41			
106	Graph	2	x	dynamic resonance		24		0.182			105.8	40.4			
106	Graph	2	x	dynamic resonance		63		0.182			105.1	40.3			
106	Graph	2	x	dynamic resonance		107		0.182			104.3	40.3			
106	Graph	2	x	dynamic resonance		159		0.182			104.2	40.2			
106	Graph	2	x	dynamic resonance		206		0.182			103.5	40.1			
106	Graph	2	x	dynamic resonance		260		0.182			102.7	39.3			
106	Graph	2	x	dynamic resonance		314		0.182			102.6	39.2			
106	Graph	2	x	dynamic resonance		363		0.182			101.8	39.1			
106	Graph	2	x	dynamic resonance		400		0.182			101.1	39.0			
106	Graph	2	x	dynamic resonance		452		0.182			101.0	38.9			
106	Graph	2	x	dynamic resonance		499		0.182			100.2	38.8			
106	Graph	2	x	dynamic resonance		535		0.182			100.2	38.1			
106	Graph	2	x	dynamic resonance		597		0.182			98.7	38.0			
106	Graph	2	x	dynamic resonance		626		0.182			98.7	37.9			
106	Graph	2	x	dynamic resonance		687		0.182			97.9	37.8			
106	Graph	2	x	dynamic resonance		722		0.182			97.8	37.7			
106	Graph	2	x	dynamic resonance		756		0.182			97.1	37.7			
106	Graph	2	x	dynamic resonance		806		0.182			97.0	37.6			
106	Graph	2	x	dynamic resonance		835		0.182			96.3	36.8			
106	Graph	2	x	dynamic resonance		899		0.182			95.5	36.7			
106	Graph	2	x	dynamic resonance		946		0.182			94.7	36.6			

Ho_2O_3 { holmium oxide, holmia }

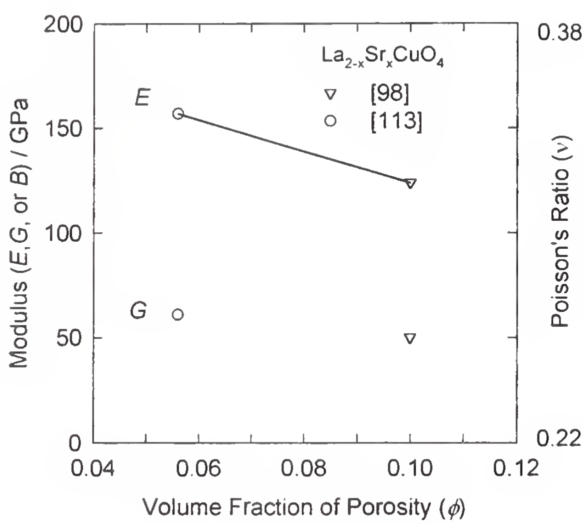
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
106	Graph	2	x	dynamic resonance		23		0.133			116.4	46.4			
106	Graph	2	x	dynamic resonance		58		0.133			115.6	45.6			
106	Graph	2	x	dynamic resonance		102		0.133			114.9	45.6			
106	Graph	2	x	dynamic resonance		151		0.133			114.1	45.5			
106	Graph	2	x	dynamic resonance		210		0.133			113.4	44.7			
106	Graph	2	x	dynamic resonance		256		0.133			112.6	44.6			
106	Graph	2	x	dynamic resonance		311		0.133			112.5	44.5			
106	Graph	2	x	dynamic resonance		357		0.133			111.8	44.4			
106	Graph	2	x	dynamic resonance		421		0.133			111.0	43.6			
106	Graph	2	x	dynamic resonance		483		0.133			110.2	43.5			
106	Graph	2	x	dynamic resonance		547		0.133			108.7	43.4			
106	Graph	2	x	dynamic resonance		596		0.133			108.6	43.3			
106	Graph	2	x	dynamic resonance		618		0.133			107.9	43.2			
106	Graph	2	x	dynamic resonance		726		0.133			107.0	42.3			
106	Graph	2	x	dynamic resonance		763		0.133			106.3	42.3			
106	Graph	2	x	dynamic resonance		817		0.133			106.2	42.2			
106	Graph	2	x	dynamic resonance		842		0.133			106.2	42.1			
106	Graph	2	x	dynamic resonance		888		0.133			104.8	42.0			
106	Graph	2	x	dynamic resonance		938		0.133			104.6	41.3			
106	Graph	2	x	dynamic resonance		992		0.133			103.9	41.1			
106	Graph	2	x	dynamic resonance		25		0.074			146.1	55.0			
106	Graph	2	x	dynamic resonance		74		0.074			144.7	54.8			
106	Graph	2	x	dynamic resonance		111		0.074			143.9	54.8			
106	Graph	2	x	dynamic resonance		155		0.074			143.8	54.7			
106	Graph	2	x	dynamic resonance		211		0.074			142.4	53.9			
106	Graph	2	x	dynamic resonance		243		0.074			141.7	53.9			
106	Graph	2	x	dynamic resonance		283		0.074			141.0	53.8			
106	Graph	2	x	dynamic resonance		327		0.074			140.2	53.7			
106	Graph	2	x	dynamic resonance		391		0.074			139.4	52.9			
106	Graph	2	x	dynamic resonance		440		0.074			138.7	52.8			
106	Graph	2	x	dynamic resonance		504		0.074			137.9	52.7			
106	Graph	2	x	dynamic resonance		558		0.074			137.1	51.9			
106	Graph	2	x	dynamic resonance		602		0.074			136.4	51.8			

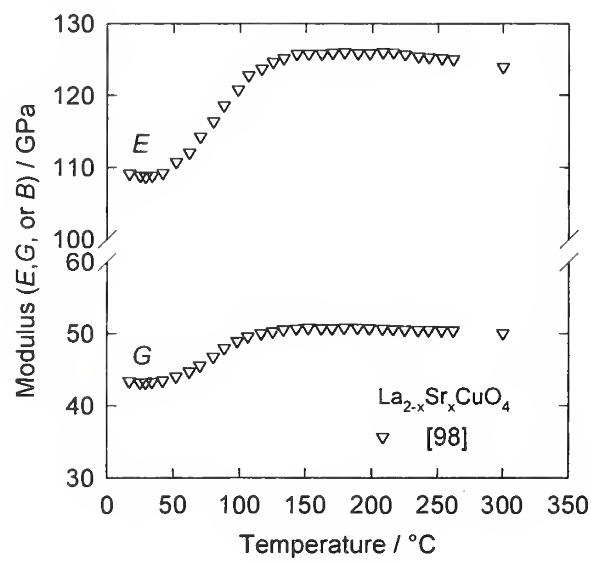
Ho_2O_3 { holmium oxide, holmia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
106	Graph	2	x	dynamic resonance		631		0.074			135.6	51.8			
106	Graph	2	x	dynamic resonance		656		0.074			135.6	51.7			
106	Graph	2	x	dynamic resonance		749		0.074			134.1	51.5			
106	Graph	2	x	dynamic resonance		804		0.074			133.3	50.8			
106	Graph	2	x	dynamic resonance		833		0.074			133.3	50.7			
106	Graph	2	x	dynamic resonance		868		0.074			132.5	50.6			
106	Graph	2	x	dynamic resonance		929		0.074			131.1	49.9			
106	Graph	2	x	dynamic resonance		993		0.074			129.6	49.7			

9.23 $La_{2-x}Sr_xCuO_{4-y}$ { La(Sr):21 }

M_r / (g mol^{-1}) = 405.355 - 51.286x - 15.999y	Temperature range / (°C) = -256 to 27
ρ_{theo} / (g cm^{-3}) = 6.94 for $La_{1.85}Sr_{0.15}CuO_4$	Porosity range = 0.06 to 0.10
	E_o / (GPa) = n/a B_o / (GPa) = n/a
	a / (10^{-4} °C) = n/a b / (10^{-4} °C) = n/a
	n = n/a m = n/a





$La_{2-x}Sr_xCuO_{4-y}$ { La(Sr):21 }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
98	Table	1	x	ultrasonic velocity		27	6.22		4.834	2.838	124	50.1	78.5	0.24	1
98	Graph	1	x	ultrasonic velocity		-256					109.12	43.40	73.89	0.2576	1
98	Graph	1	x	ultrasonic velocity		-248					108.85	43.24	73.88	0.2584	1
98	Graph	1	x	ultrasonic velocity		-244					108.71	43.24	73.97	0.2584	1
98	Graph	1	x	ultrasonic velocity		-239					108.83	43.34	74.05	0.2584	1
98	Graph	1	x	ultrasonic velocity		-231					109.23	43.50	74.29	0.2581	1
98	Graph	1	x	ultrasonic velocity		-221					110.79	44.07	74.54	0.2561	1
98	Graph	1	x	ultrasonic velocity		-211					112.10	44.76	75.03	0.2545	1
98	Graph	1	x	ultrasonic velocity		-203					114.32	45.61	75.60	0.2525	1
98	Graph	1	x	ultrasonic velocity		-193					116.40	46.82	76.26	0.2496	1
98	Graph	1	x	ultrasonic velocity		-185					118.62	47.98	77.17	0.2479	1
98	Graph	1	x	ultrasonic velocity		-175					120.85	48.98	78.16	0.2456	1
98	Graph	1	x	ultrasonic velocity		-167					122.81	49.61	78.91	0.2448	1
98	Graph	1	x	ultrasonic velocity		-157					123.71	50.03	79.39	0.2443	1
98	Graph	1	x	ultrasonic velocity		-148					124.62	50.30	79.89	0.2440	1
98	Graph	1	x	ultrasonic velocity		-140					125.14	50.56	80.13	0.2437	1
98	Graph	1	x	ultrasonic velocity		-130					125.79	50.72	80.38	0.2437	1
98	Graph	1	x	ultrasonic velocity		-121					125.79	50.77	80.62	0.2434	1
98	Graph	1	x	ultrasonic velocity		-111					125.77	50.76	80.70	0.2434	1
98	Graph	1	x	ultrasonic velocity		-103					125.90	50.76	80.70	0.2437	1
98	Graph	1	x	ultrasonic velocity		-94					126.02	50.81	80.69	0.2439	1
98	Graph	1	x	ultrasonic velocity		-84					125.87	50.81	80.68	0.2439	1
98	Graph	1	x	ultrasonic velocity		-75					125.87	50.75	80.68	0.2439	1
98	Graph	1	x	ultrasonic velocity		-65					126.00	50.69	80.67	0.2436	1
98	Graph	1	x	ultrasonic velocity		-57					125.98	50.64	80.59	0.2436	1
98	Graph	1	x	ultrasonic velocity		-48					125.71	50.58	80.42	0.2438	1
98	Graph	1	x	ultrasonic velocity		-38					125.44	50.53	80.24	0.2430	1
98	Graph	1	x	ultrasonic velocity		-30					125.30	50.52	79.83	0.2428	1
98	Graph	1	x	ultrasonic velocity		-20					125.17	50.47	79.65	0.2423	1
98	Graph	1	x	ultrasonic velocity		-11					125.03	50.46	79.57	0.2420	1
113	Table	I	x	ultrasonic velocity		23	6.55				157	61			1

$La_{2-x}Sr_xCuO_{4-y}$ { La(Sr):21 }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
114	Table	I	x	x-ray diffraction		23	6.94								2

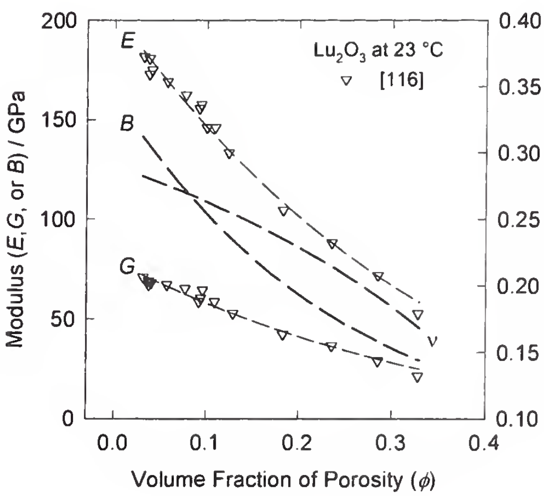
Footnotes:

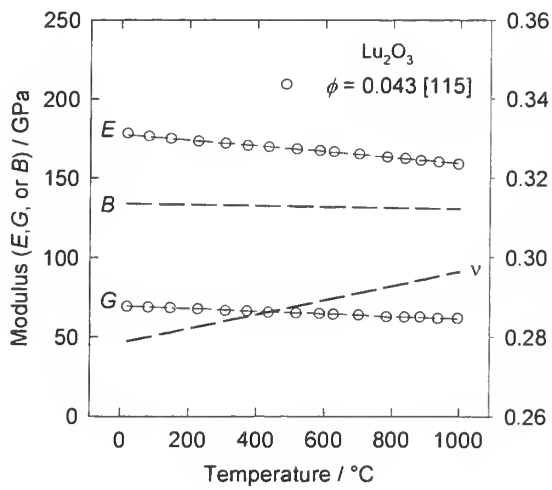
1: $La_{1.85}Sr_{0.15}CuO_4$

2: Theoretical density for $La_{1.85}Sr_{0.15}CuO_4$ as calculated from the reported lattice parameters.

9.24 Lu_2O_3 { lutetium oxide, lutetia }

M_r / (g mol^{-1}) = 397.932	Temperature range / (°C) = 0 to 1000	
ρ_{theo} / (g cm^{-3}) = 9.423	Porosity range = 0 to 0.34	
	E_o / (GPa) = 204	B_o / (GPa) = 161
	a / (10^{-4}°C) = 1.03	b / (10^{-4}°C) = 0.24
	n = 3.12	m = 4.27





Lu_2O_3 { lutetium oxide, lutetia }

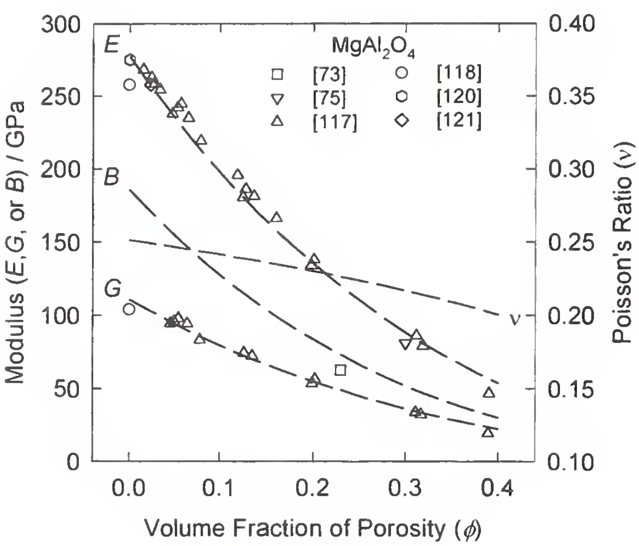
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
115	Graph	1	x	sonic resonance		20	9.022				178.3	69.2			
115	Graph	1	x	sonic resonance		82					176.5	68.8			
115	Graph	1	x	sonic resonance		146					175.1	68.4			
115	Graph	1	x	sonic resonance		227					173.4	67.5			
115	Graph	1	x	sonic resonance		308					172.0	66.7			
115	Graph	1	x	sonic resonance		372					170.6	66.3			
115	Graph	1	x	sonic resonance		435					169.7	65.5			
115	Graph	1	x	sonic resonance		517					168.4	65.1			
115	Graph	1	x	sonic resonance		584					167.4	64.7			
115	Graph	1	x	sonic resonance		625					166.6	64.3			
115	Graph	1	x	sonic resonance		700					165.2	63.9			
115	Graph	1	x	sonic resonance		783					163.4	63.1			
115	Graph	1	x	sonic resonance		837					162.5	62.7			
115	Graph	1	x	sonic resonance		883					161.2	62.7			
115	Graph	1	x	sonic resonance		937					160.3	61.9			
115	Graph	1	x	sonic resonance		996					158.9	61.9			
115	Table	II	x	sonic resonance		20	9.022						139.7	0.287	
115	Table	II	x	sonic resonance		82							138.6	0.288	
115	Table	II	x	sonic resonance		146							137.4	0.288	
115	Table	II	x	sonic resonance		227							136.8	0.289	
115	Table	II	x	sonic resonance		308							135.3	0.288	
115	Table	II	x	sonic resonance		372							133.5	0.287	
115	Table	II	x	sonic resonance		435							133.2	0.288	
115	Table	II	x	sonic resonance		517							132.7	0.288	
115	Table	II	x	sonic resonance		584							132.7	0.290	
115	Table	II	x	sonic resonance		625							131.7	0.290	
115	Table	II	x	sonic resonance		700							131.0	0.290	
115	Table	II	x	sonic resonance		783							129.0	0.289	
115	Table	II	x	sonic resonance		837							128.5	0.289	
115	Table	II	x	sonic resonance		883							128.0	0.289	
115	Table	II	x	sonic resonance		937							126.3	0.288	
115	Table	II	x	sonic resonance		996							125.8	0.289	

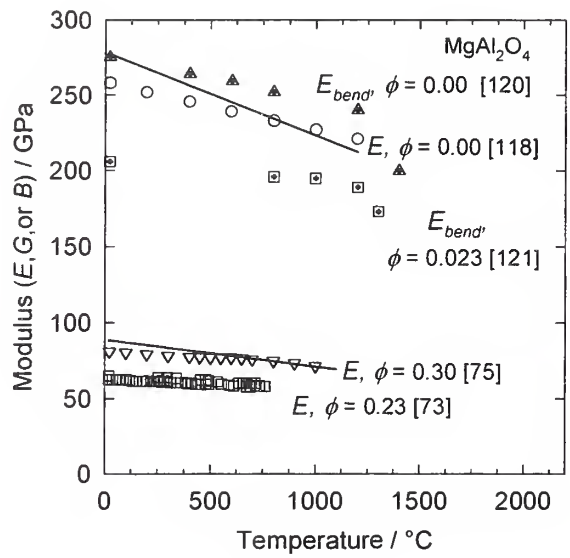
Lu_2O_3 { lutetium oxide, lutetia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
116	Graph	1	x	sonic resonance		23		0.031			181.7	71.0			
116	Graph	1	x	sonic resonance		23		0.037			180.7	69.1			
116	Graph	1	x	sonic resonance		23		0.037			172.9	67.1			
116	Graph	1	x	sonic resonance		23		0.040			174.9	68.1			
116	Graph	1	x	sonic resonance		23		0.057			169.1	67.2			
116	Graph	1	x	sonic resonance		23		0.077			162.4	65.3			
116	Graph	1	x	sonic resonance		23		0.092			155.7	58.6			
116	Graph	1	x	sonic resonance		23		0.094			157.6	60.5			
116	Graph	1	x	sonic resonance		23		0.096				64.4			
116	Graph	1	x	sonic resonance		23		0.100			146.0				
116	Graph	1	x	sonic resonance		23		0.109			146.0	58.6			
116	Graph	1	x	sonic resonance		23		0.124			133.4				
116	Graph	1	x	sonic resonance		23		0.129				52.9			
116	Graph	1	x	sonic resonance		23		0.183			104.5	42.4			
116	Graph	1	x	sonic resonance		23		0.235			88.2	36.7			
116	Graph	1	x	sonic resonance		23		0.285			71.9	29.1			
116	Graph	1	x	sonic resonance		23		0.328			52.6	21.5			

9.25 $MgAl_2O_4$ { magnesium aluminate (spinel), $MgO{\cdot}Al_2O_3$ }

M_r / (g mol^{-1}) = 142.266 ρ_{theo} / (g cm^{-3}) = 3.572	Temperature range / (°C) = 0 to 1200 Porosity range = 0 to 0.38	
	E_o / (GPa) = 278 a / (10^{-4}°C) = 1.98 n = 3.20	B_o / (GPa) = 187 b / (10^{-4}°C) = 1.97 m = 3.57





$MgAl_2O_4$ { magnesium aluminate (spinel) }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
73	Graph	4	x	sonic resonance		20		0.23			62.7				1
73	Graph	4	x	sonic resonance		37					62.7				1
73	Graph	4	x	sonic resonance		58					62.7				1
73	Graph	4	x	sonic resonance		75					62.7				1
73	Graph	4	x	sonic resonance		101					62.7				1
73	Graph	4	x	sonic resonance		118					62.1				1
73	Graph	4	x	sonic resonance		135					61.6				1
73	Graph	4	x	sonic resonance		152					61.6				1
73	Graph	4	x	sonic resonance		181					61.6				1
73	Graph	4	x	sonic resonance		198					61.6				1
73	Graph	4	x	sonic resonance		220					61.6				1
73	Graph	4	x	sonic resonance		237					61.6				1
73	Graph	4	x	sonic resonance		258					61.1				1
73	Graph	4	x	sonic resonance		279					61.7				1
73	Graph	4	x	sonic resonance		296					61.1				1
73	Graph	4	x	sonic resonance		313					60.6				1
73	Graph	4	x	sonic resonance		339					60.6				1
73	Graph	4	x	sonic resonance		360					60.6				1
73	Graph	4	x	sonic resonance		382					60.6				1
73	Graph	4	x	sonic resonance		394					60.0				1
73	Graph	4	x	sonic resonance		411					60.0				1
73	Graph	4	x	sonic resonance		433					59.5				1
73	Graph	4	x	sonic resonance		454					59.5				1
73	Graph	4	x	sonic resonance		479					59.5				1
73	Graph	4	x	sonic resonance		492					59.5				1
73	Graph	4	x	sonic resonance		552					59.6				1
73	Graph	4	x	sonic resonance		590					59.0				1
73	Graph	4	x	sonic resonance		611					58.5				1
73	Graph	4	x	sonic resonance		675					57.9				1
73	Graph	4	x	sonic resonance		692					57.9				1
73	Graph	4	x	sonic resonance		718					58.5				1
73	Graph	4	x	sonic resonance		735					58.5				1

$MgAl_2O_4$ { magnesium aluminate (spinel) }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
73	Graph	4	x	sonic resonance		760					58.0				1
73	Graph	4	x	sonic resonance		713					60.2				2
73	Graph	4	x	sonic resonance		696					60.2				2
73	Graph	4	x	sonic resonance		675					60.2				2
73	Graph	4	x	sonic resonance		658					60.2				2
73	Graph	4	x	sonic resonance		637					60.2				2
73	Graph	4	x	sonic resonance		535					61.2				2
73	Graph	4	x	sonic resonance		492					61.8				2
73	Graph	4	x	sonic resonance		479					62.3				2
73	Graph	4	x	sonic resonance		454					62.3				2
73	Graph	4	x	sonic resonance		339					63.4				2
73	Graph	4	x	sonic resonance		296					63.9				2
73	Graph	4	x	sonic resonance		254					63.9				2
73	Graph	4	x	sonic resonance		20					64.9				2
75	Table	II	x	sonic resonance		23	2.50				81.1				
75	Graph	4	x	sonic resonance		23	2.50				81.1				
75	Graph	4	x	sonic resonance		100					80.3				
75	Graph	4	x	sonic resonance		200					79.3				
75	Graph	4	x	sonic resonance		300					78.3				
75	Graph	4	x	sonic resonance		400					77.7				
75	Graph	4	x	sonic resonance		450					77.3				
75	Graph	4	x	sonic resonance		500					77.0				
75	Graph	4	x	sonic resonance		550					77.0				
75	Graph	4	x	sonic resonance		600					77.0				
75	Graph	4	x	sonic resonance		650					76.6				
75	Graph	4	x	sonic resonance		700					76.0				
75	Graph	4	x	sonic resonance		800					74.9				
75	Graph	4	x	sonic resonance		900					73.4				
75	Graph	4	x	sonic resonance		1000					71.5				
117	Graph	3A	x	sonic resonance		23		0.015			268.2				
117	Graph	3A	x	sonic resonance		23		0.024			262.7				

$MgAl_2O_4$ { magnesium aluminate (spinel) }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
117	Graph	3A	x	sonic resonance		23		0.027			258.6				
117	Graph	3A	x	sonic resonance		23		0.033			254.4				
117	Graph	3A	x	sonic resonance		23		0.047			237.9				
117	Graph	3A	x	sonic resonance		23		0.053			242				
117	Graph	3A	x	sonic resonance		23		0.057			244.8				
117	Graph	3A	x	sonic resonance		23		0.065			235.1				
117	Graph	3A	x	sonic resonance		23		0.079			219.3				
117	Graph	3A	x	sonic resonance		23		0.119			195.8				
117	Graph	3A	x	sonic resonance		23		0.125			180.6				
117	Graph	3A	x	sonic resonance		23		0.128			186.2				
117	Graph	3A	x	sonic resonance		23		0.137			181.3				
117	Graph	3A	x	sonic resonance		23		0.161			166.2				
117	Graph	3A	x	sonic resonance		23		0.201			137.9				
117	Graph	3A	x	sonic resonance		23		0.198			133.8				
117	Graph	3A	x	sonic resonance		23		0.312			86.2				
117	Graph	3A	x	sonic resonance		23		0.319			79.3				
117	Graph	3A	x	sonic resonance		23		0.390			46.9				
117	Graph	3B	x	sonic resonance		23		0.045				94.5			
117	Graph	3B	x	sonic resonance		23		0.049				95.8			
117	Graph	3B	x	sonic resonance		23		0.054				97.9			
117	Graph	3B	x	sonic resonance		23		0.064				94.5			
117	Graph	3B	x	sonic resonance		23		0.078				83.4			
117	Graph	3B	x	sonic resonance		23		0.126				74.5			
117	Graph	3B	x	sonic resonance		23		0.135				72.4			
117	Graph	3B	x	sonic resonance		23		0.202				56.5			
117	Graph	3B	x	sonic resonance		23		0.199				53.8			
117	Graph	3B	x	sonic resonance		23		0.311				33.8			
117	Graph	3B	x	sonic resonance		23		0.317				32.4			
117	Graph	3B	x	sonic resonance		23		0.389				19.3			
118	Text	620	x	sonic resonance		23					258	104			3
118	Text	620	s	sonic resonance		200					252				3
118	Text	620	s	sonic resonance		400					246				3

$MgAl_2O_4$ { magnesium aluminate (spinel) }

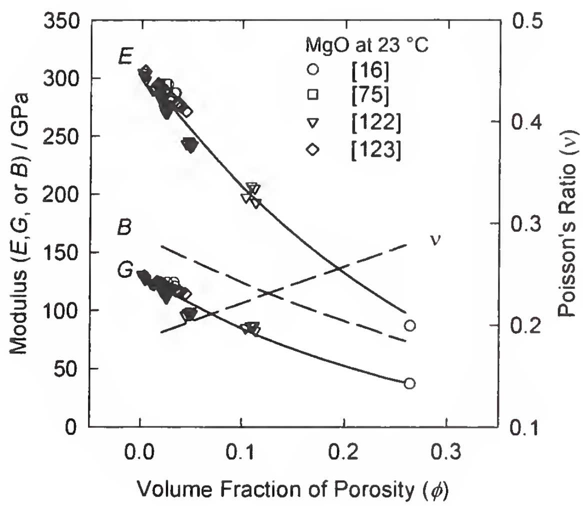
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
118	Text	620	s	sonic resonance		600					239				3
118	Text	620	s	sonic resonance		800					233				3
118	Text	620	s	sonic resonance		1000					227				3
118	Text	620	s	sonic resonance		1200					221				3
119	Text	1624	x	unknown		23	3.58				258				
120	Text	3441	x	ultrasonic method		23					275				4
120	Graph	5	x	bending (3-pt)		23					275				4
120	Graph	5	x	bending (3-pt)		400					264				4
120	Graph	5	x	bending (3-pt)		600					259				4
120	Graph	5	x	bending (3-pt)		800					252				4
120	Graph	5	x	bending (3-pt)		1200					240				4
120	Graph	5	x	bending (3-pt)		1400					200				4
121	Text	1858	x	sonic resonance		23	3.491				258				
121	Graph	5	x	bending (4-pt)		23	3.491				206				
121	Graph	5	x	bending (4-pt)		800					196				
121	Graph	5	x	bending (4-pt)		1000					195				
121	Graph	5	x	bending (4-pt)		1200					189				
121	Graph	5	x	bending (4-pt)		1300					173				

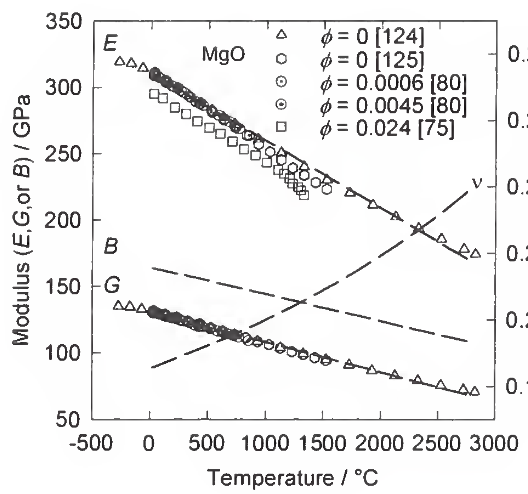
Footnotes:

1: On heating
2: On cooling
3: Translucent specimen
4: Transparent specimen

9.26 MgO { magnesium oxide, magnesia }

M_r / (g mol^{-1}) = 40.304	Temperature range / (°C) = 0 to 2500	
ρ_{theo} / (g cm^{-3}) = 3.58	Porosity range = 0 to 0.26	
	E_o / (GPa) = 310	B_o / (GPa) = 164
	a / (10^{-4}°C) = 1.63	b / (10^{-4}°C) = 1.23
	n = 3.81	m = 2.64





MgO { magnesium oxide, magnesia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
16	Table	6	x	resonance		23	3.506				294.7	124.3	156.4	0.186	
16	Table	6	x	resonance		23	3.483				287.3	124.2	140.1	0.157	
16	Table	6	x	resonance		23	3.479				287.2	120.7	156.4	0.191	
16	Table	6	x	resonance		23	2.648				87	37.4	43	0.163	
75	Table	II	x	sonic resonance		23	3.50	0.02371			295				
75	Graph	3	x	sonic resonance		23	3.50				294.9				
75	Graph	3	x	sonic resonance		100					291.9				
75	Graph	3	x	sonic resonance		200					284.9				
75	Graph	3	x	sonic resonance		300					279.9				
75	Graph	3	x	sonic resonance		400					274.4				
75	Graph	3	x	sonic resonance		500					269.3				
75	Graph	3	x	sonic resonance		600					264.8				
75	Graph	3	x	sonic resonance		700					258.8				
75	Graph	3	x	sonic resonance		800					253.3				
75	Graph	3	x	sonic resonance		900					248.7				
75	Graph	3	x	sonic resonance		1000					243.2				
75	Graph	3	x	sonic resonance		1100					237.7				
75	Graph	3	x	sonic resonance		1150					234.7				
75	Graph	3	x	sonic resonance		1200					231.2				
75	Graph	3	x	sonic resonance		1225					227.2				
75	Graph	3	x	sonic resonance		1275					224.6				
75	Graph	3	x	sonic resonance		1300					222.1				
75	Graph	3	x	sonic resonance		1325					218.6				
80	Table	I	x	dynamic resonance		25	3.581	0.0006			309.7	130.6	164.4		
80	Graph	1	x	dynamic resonance		33		0.0006			309.1	130.3			
80	Graph	1	x	dynamic resonance		54		0.0006			308.3	130.0			
80	Graph	1	x	dynamic resonance		76		0.0006			307.0	129.3			
80	Graph	1	x	dynamic resonance		182		0.0006			300.8	126.5			
80	Graph	1	x	dynamic resonance		197		0.0006			300.4	126.2			
80	Graph	1	x	dynamic resonance		227		0.0006			299.1	125.7			

MgO { magnesium oxide, magnesia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
80	Graph	1	x	dynamic resonance		254		0.0006			297.5	124.9			
80	Graph	1	x	dynamic resonance		282		0.0006			296.0	123.8			
80	Graph	1	x	dynamic resonance		340		0.0006			292.3	122.6			
80	Graph	1	x	dynamic resonance		449		0.0006			286.1	119.8			
80	Graph	1	x	dynamic resonance		522		0.0006			282.4	118.0			
80	Graph	1	x	dynamic resonance		582		0.0006			278.8	116.5			
80	Graph	1	x	dynamic resonance		632		0.0006			276.2	115.2			
80	Graph	1	x	dynamic resonance		680		0.0006			273.8	114.2			
80	Graph	1	x	dynamic resonance		722		0.0006			271.1	112.9			
80	Graph	1	x	dynamic resonance		764		0.0006			268.7	111.7			
80	Graph	1	x	dynamic resonance		847		0.0006			263.6	109.2			
80	Table	I	x	dynamic resonance		25	3.567	0.0045			308.7	130.1	164.1		
80	Graph	1	x	dynamic resonance		125		0.0045			303.8	127.7			
80	Graph	1	x	dynamic resonance		143		0.0045			303.1	127.4			
80	Graph	1	x	dynamic resonance		387		0.0045			288.9	120.8			
80	Graph	1	x	dynamic resonance		422		0.0045			287.4	119.9			
122	Graph	1	x	resonance		23		0.0102			290.2	123.0			
122	Graph	1	x	resonance		23		0.0186			285.2	121.4			
122	Graph	1	x	resonance		23		0.0206			278.6	116.4			
122	Graph	1	x	resonance		23		0.0233			278.3	117.2			
122	Graph	1	x	resonance		23		0.0225			273.7	116.4			
122	Graph	1	x	resonance		23		0.0235			270.3	116.7			
122	Graph	1	x	resonance		23		0.0245			275.3	116.7			
122	Graph	1	x	resonance		23		0.0255			271.2	115.6			
122	Graph	1	x	resonance		23		0.046			245.8	98.0			
122	Graph	1	x	resonance		23		0.047			244.7	96.6			
122	Graph	1	x	resonance		23		0.048			242.9	96.6			
122	Graph	1	x	resonance		23		0.0485			242.9	99.0			
122	Graph	1	x	resonance		23		0.1037			197.5	85.0			
122	Graph	1	x	resonance		23		0.1134			192.9	83.0			
122	Graph	1	x	resonance		23		0.001			304.7	130.8			
122	Graph	1	x	resonance		23		0.002			301.2	129.8			

MgO { magnesium oxide, magnesia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
122	Graph	1	x	resonance		23		0.004			302.8	128.1			
122	Graph	1	x	resonance		23		0.004			298.6	126.4			
122	Graph	1	x	resonance		23		0.011			290.4	124.2			
122	Graph	1	x	resonance		23		0.013			290.4	122.4			
122	Graph	1	x	resonance		23		0.019			281.4	119.5			
122	Graph	1	x	resonance		23		0.02			283.1	121.1			
122	Graph	1	x	resonance		23		0.021			283.0	116.7			
122	Graph	1	x	resonance		23		0.023			273.6	114.1			
122	Graph	1	x	resonance		23		0.024			275.2	115.8			
122	Graph	1	x	resonance		23		0.025			270.1	112.3			
122	Graph	1	x	resonance		23		0.025			272.6	110.5			
122	Graph	1	x	resonance		23		0.044			243.4	95.8			
122	Graph	1	x	resonance		23		0.048			240.6	97.2			
122	Graph	1	x	resonance		23		0.05			242.2	97.1			
122	Graph	1	x	resonance		23		0.109			207.0	86.6			
122	Graph	1	x	resonance		23		0.112			205.2	87.3			
123	Graph	1	x	resonant sphere		23		0.0033		6.026					
123	Graph	1	x	resonant sphere		23		0.0035		6.023					
123	Graph	1	x	resonant sphere		23		0.0037		6.019					
123	Graph	1	x	resonant sphere		23		0.0158		5.945					
123	Graph	1	x	resonant sphere		23		0.0163		5.948					
123	Graph	1	x	resonant sphere		23		0.0165		5.936					
123	Graph	1	x	resonant sphere		23		0.0174		5.93					
123	Graph	1	x	resonant sphere		23		0.0192		5.932					
123	Graph	1	x	resonant sphere		23		0.0204		5.928					
123	Graph	1	x	resonant sphere		23		0.0222		5.901					
123	Graph	1	x	resonant sphere		23		0.0222		5.897					
123	Graph	1	x	resonant sphere		23		0.0234		5.9					
123	Graph	1	x	resonant sphere		23		0.03		5.845					
123	Graph	1	x	resonant sphere		23		0.034		5.818					
123	Graph	1	x	resonant sphere		23		0.037		5.818					
123	Graph	1	x	resonant sphere		23		0.0386		5.802					

MgO { magnesium oxide, magnesia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
123	Graph	1	x	resonant sphere		23		0.0437		5.778					
123	Graph	2	x	resonant sphere		23		0.0033						0.18	
123	Graph	2	x	resonant sphere		23		0.0035						0.18	
123	Graph	2	x	resonant sphere		23		0.0039						0.183	
123	Graph	2	x	resonant sphere		23		0.004						0.181	
123	Graph	2	x	resonant sphere		23		0.0158						0.183	
123	Graph	2	x	resonant sphere		23		0.0163						0.184	
123	Graph	2	x	resonant sphere		23		0.0165						0.182	
123	Graph	2	x	resonant sphere		23		0.0174						0.182	
123	Graph	2	x	resonant sphere		23		0.0192						0.183	
123	Graph	2	x	resonant sphere		23		0.0204						0.183	
123	Graph	2	x	resonant sphere		23		0.0222						0.185	
123	Graph	2	x	resonant sphere		23		0.0222						0.183	
123	Graph	2	x	resonant sphere		23		0.0234						0.185	
123	Graph	2	x	resonant sphere		23		0.03						0.188	
123	Graph	2	x	resonant sphere		23		0.034						0.185	
123	Graph	2	x	resonant sphere		23		0.037						0.189	
123	Graph	2	x	resonant sphere		23		0.0386						0.187	
123	Graph	2	x	resonant sphere		23		0.0437						0.187	
124	Table	7b	x	sonic resonance		-273	3.603	0			319.1	135.2		0.180	1
124	Table	7b	x	sonic resonance		-173	3.602				317.7	134.6		0.180	1
124	Table	7b	x	sonic resonance		-73					314.4	133		0.182	1
124	Table	7b	x	sonic resonance		27					309.6	130.9		0.183	1
124	Table	7b	x	sonic resonance		127					304.4	128.4		0.185	1
124	Table	7b	x	sonic resonance		227					299.0	125.8		0.188	1
124	Table	7b	x	sonic resonance		327					293.6	123.4		0.190	1
124	Table	7b	x	sonic resonance		427					288.2	120.9		0.192	1
124	Table	7b	x	sonic resonance		527					282.8	118.4		0.194	1
124	Table	7b	x	sonic resonance		627					277.2	115.9		0.196	1
124	Table	7b	x	sonic resonance		727					271.8	113.4		0.198	1
124	Table	7b	x	sonic resonance		927					261.0	108.6		0.202	1
124	Table	7b	c	sonic resonance		1127					250.5	103.9		0.205	1

MgO { magnesium oxide, magnesia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
124	Table	7b	c	sonic resonance		1327					240.0	99.5		0.206	1
124	Table	7b	c	sonic resonance		1527					230.1	95.2		0.209	1
124	Table	7b	c	sonic resonance		1727					220.5	91		0.212	1
124	Table	7b	c	sonic resonance		1927					211.2	86.9		0.215	1
124	Table	7b	c	sonic resonance		2127					202.3	83		0.218	1
124	Table	7b	c	sonic resonance		2327					193.8	79.4		0.221	1
124	Table	7b	c	sonic resonance		2527					185.7	75.9		0.224	1
124	Table	7b	c	sonic resonance		2727					178.0	72.5		0.227	1
124	Table	7b	c	sonic resonance		2827					174.3	70.9		0.229	1
125	Table	4	x	resonance		27	3.585	0					161.6		2
125	Table	4	x	resonance		127	3.573						158.9		2
125	Table	4	x	resonance		227	3.559						156.1		2
125	Table	4	x	resonance		327	3.545						153.2		2
125	Table	4	x	resonance		427	3.531						150.5		2
125	Table	4	x	resonance		527	3.516						147.4		2
125	Table	4	x	resonance		627	3.501						144.4		2
125	Table	4	x	resonance		727	3.486						141.4		2
125	Table	4	x	resonance		827	3.47						138.3		2
125	Table	4	x	resonance		927	3.454						135.1		2
125	Table	4	x	resonance		1027	3.438						132.1		2
125	Table	4	x	resonance		1127	3.422						128.9		2
125	Table	4	x	resonance		1227	3.405						125.7		2
125	Table	4	x	resonance		1327	3.388						122.5		2
125	Table	4	x	resonance		1427	3.371						119.6		2
125	Table	4	x	resonance		1527	3.354						116.6		2
125	Table	5	x	resonance		27	3.585							0.179	2
125	Table	5	x	resonance		127	3.573							0.18	2
125	Table	5	x	resonance		227	3.559							0.18	2
125	Table	5	x	resonance		327	3.545							0.181	2
125	Table	5	x	resonance		427	3.531							0.181	2
125	Table	5	x	resonance		527	3.516							0.182	2
125	Table	5	x	resonance		627	3.501							0.182	2

MgO { magnesium oxide, magnesia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
125	Table	5	x	resonance		727	3.486							0.182	2
125	Table	5	x	resonance		827	3.47							0.182	2
125	Table	5	x	resonance		927	3.454							0.183	2
125	Table	5	x	resonance		1027	3.438							0.183	2
125	Table	5	x	resonance		1127	3.422							0.183	2
125	Table	5	x	resonance		1227	3.405							0.183	2
125	Table	5	x	resonance		1327	3.388							0.182	2
125	Table	5	x	resonance		1427	3.371							0.182	2
125	Table	5	x	resonance		1527	3.354							0.181	2

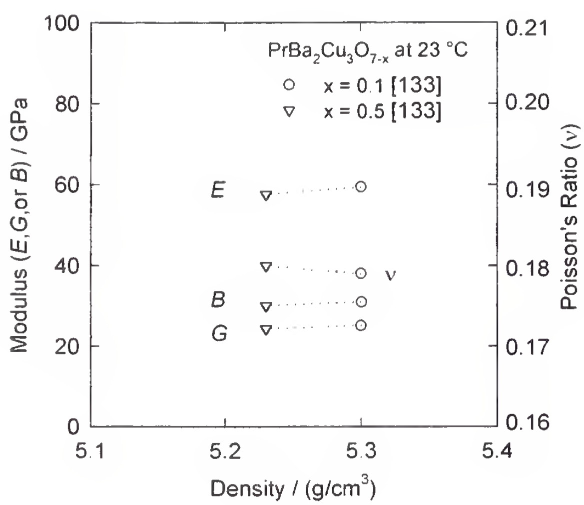
Footnotes:

1 Single crystal specimen

2 Rectangular parallelepiped resonance method

9.27 $PrBa_2Cu_3O_{7-x}$ { Pr:123 }

M_r / (g mol^{-1}) = 718.196-15.999x	Temperature range / (°C) = 23 to 23	
ρ_{theo} / (g cm^{-3}) = 6.73 (x=0.1), 6.54 (x = 0.5)	Porosity range = 0.20 to 0.21	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a



$PrBa_2Cu_3O_{7-x}$ { Pr:123 }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
133	Table	2	x	ult. pulse echo		23	5.30	0.212	3.489	2.179	59.4	25.2	31.0		1
133	Table	2	x	ult. pulse echo		23	5.23	0.200	3.458	2.158	57.6	24.4	30.1		2

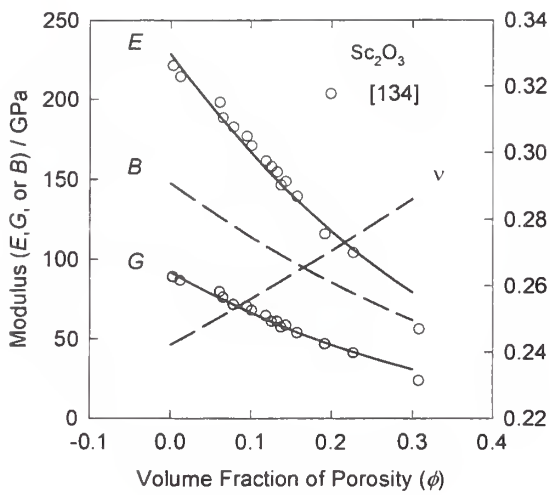
Footnotes:

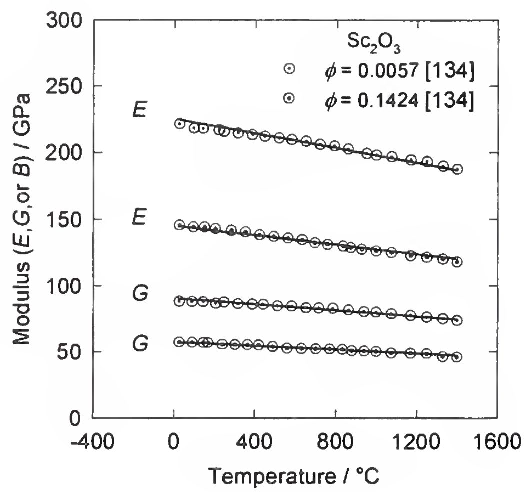
1: $PrBa_2Cu_3O_{6.9}$

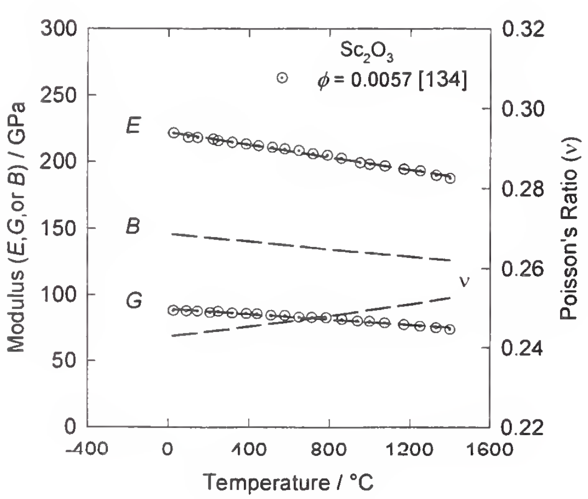
2: $PrBa_2Cu_3O_{6.5}$

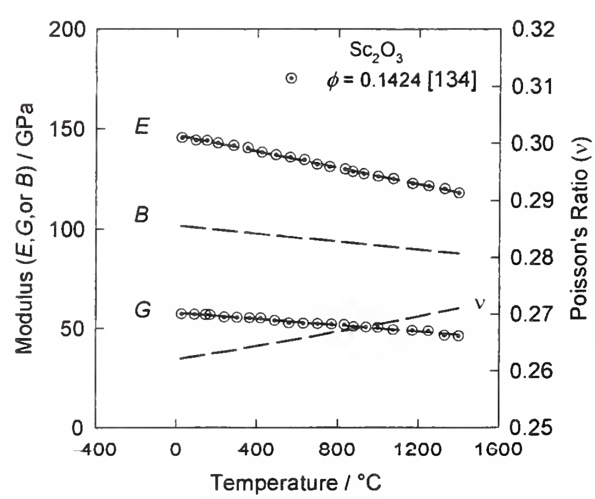
9.28 Sc_2O_3 { scandium oxide, scandia }

M_r / (g mol^{-1}) = 137.910	Temperature range / (°C) = 0 to 1400	
ρ_{theo} / (g cm^{-3}) = 3.841	Porosity range = 0 to 0.3	
	E_o / (GPa) = 229	B_o / (GPa) = 148
	a / (10^{-4}°C) = 1.22	b / (10^{-4}°C) = 0.98
	n = 2.97	m = 2.45









Sc_2O_3 { scandium oxide, scandia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
134	Graph	1	x	sonic resonance		23		0.003			221.3	89.0			
134	Graph	1	x	sonic resonance		23		0.012			214.3	86.7			
134	Graph	1	x	sonic resonance		23		0.061			197.9	79.7			
134	Graph	1	x	sonic resonance		23		0.065			188.5	76.2			
134	Graph	1	x	sonic resonance		23		0.078			182.7	71.5			
134	Graph	1	x	sonic resonance		23		0.095			176.8	70.3			
134	Graph	1	x	sonic resonance		23		0.101			171.0	68.0			
134	Graph	1	x	sonic resonance		23		0.119			161.6	64.5			
134	Graph	1	x	sonic resonance		23		0.126			158.1	61.0			
134	Graph	1	x	sonic resonance		23		0.133			154.6	61.0			
134	Graph	1	x	sonic resonance		23		0.138			146.4	57.4			
134	Graph	1	x	sonic resonance		23		0.144			148.7	58.6			
134	Graph	1	x	sonic resonance		23		0.158			139.4	53.9			
134	Graph	1	x	sonic resonance		23		0.192			116.0	46.9			
134	Graph	1	x	sonic resonance		23		0.227			104.3	41.1			
134	Graph	1	x	sonic resonance		23		0.308			56.3	23.5			
134	Graph	2	x	sonic resonance		25		0.0057			221.4				
134	Graph	2	x	sonic resonance		97		0.0057			218.2				
134	Graph	2	x	sonic resonance		143		0.0057			218.0				
134	Graph	2	x	sonic resonance		221		0.0057			216.8				
134	Graph	2	x	sonic resonance		245		0.0057			215.7				
134	Graph	2	x	sonic resonance		315		0.0057			214.5				
134	Graph	2	x	sonic resonance		385		0.0057			213.2				
134	Graph	2	x	sonic resonance		447		0.0057			212.0				
134	Graph	2	x	sonic resonance		517		0.0057			210.8				
134	Graph	2	x	sonic resonance		579		0.0057			209.6				
134	Graph	2	x	sonic resonance		650		0.0057			208.4				
134	Graph	2	x	sonic resonance		719		0.0057			206.1				
134	Graph	2	x	sonic resonance		790		0.0057			204.9				
134	Graph	2	x	sonic resonance		859		0.0057			202.6				
134	Graph	2	x	sonic resonance		952		0.0057			199.3				
134	Graph	2	x	sonic resonance		1000		0.0057			198.1				

Sc_2O_3 { scandium oxide, scandia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
134	Graph	2	x	sonic resonance		1075		0.0057			196.8				
134	Graph	2	x	sonic resonance		1170		0.0057			194.5				
134	Graph	2	x	sonic resonance		1250		0.0057			193.3				
134	Graph	2	x	sonic resonance		1330		0.0057			189.9				
134	Graph	2	x	sonic resonance		1400		0.0057			187.6				
134	Graph	2	x	sonic resonance		25		0.0057				88.1			
134	Graph	2	x	sonic resonance		89		0.0057				87.9			
134	Graph	2	x	sonic resonance		144		0.0057				87.8			
134	Graph	2	x	sonic resonance		206		0.0057				86.6			
134	Graph	2	x	sonic resonance		246		0.0057				87.5			
134	Graph	2	x	sonic resonance		316		0.0057				86.3			
134	Graph	2	x	sonic resonance		386		0.0057				86.0			
134	Graph	2	x	sonic resonance		441		0.0057				85.9			
134	Graph	2	x	sonic resonance		511		0.0057				84.7			
134	Graph	2	x	sonic resonance		581		0.0057				84.5			
134	Graph	2	x	sonic resonance		651		0.0057				83.2			
134	Graph	2	x	sonic resonance		714		0.0057				83.0			
134	Graph	2	x	sonic resonance		784		0.0057				82.8			
134	Graph	2	x	sonic resonance		862		0.0057				81.6			
134	Graph	2	x	sonic resonance		940		0.0057				80.3			
134	Graph	2	x	sonic resonance		1000		0.0057				80.1			
134	Graph	2	x	sonic resonance		1075		0.0057				78.9			
134	Graph	2	x	sonic resonance		1170		0.0057				77.6			
134	Graph	2	x	sonic resonance		1250		0.0057				76.3			
134	Graph	2	x	sonic resonance		1330		0.0057				75.1			
134	Graph	2	x	sonic resonance		1400		0.0057				73.8			
134	Graph	2	x	sonic resonance		25		0.1424			145.6				
134	Graph	2	x	sonic resonance		95		0.1424			144.3				
134	Graph	2	x	sonic resonance		150		0.1424			144.2				
134	Graph	2	x	sonic resonance		204		0.1424			143.0				
134	Graph	2	x	sonic resonance		282		0.1424			141.7				
134	Graph	2	x	sonic resonance		352		0.1424			140.5				
134	Graph	2	x	sonic resonance		422		0.1424			138.3				

Sc_2O_3 { scandium oxide, scandia }

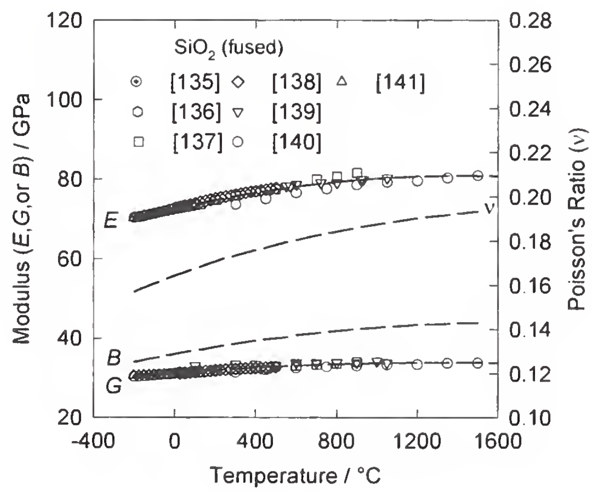
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
134	Graph	2	x	sonic resonance		492		0.1424			137.0				
134	Graph	2	x	sonic resonance		562		0.1424			135.8				
134	Graph	2	x	sonic resonance		632		0.1424			134.6				
134	Graph	2	x	sonic resonance		694		0.1424			132.3				
134	Graph	2	x	sonic resonance		757		0.1424			131.1				
134	Graph	2	x	sonic resonance		834		0.1424			129.9				
134	Graph	2	x	sonic resonance		873		0.1424			128.7				
134	Graph	2	x	sonic resonance		928		0.1424			127.5				
134	Graph	2	x	sonic resonance		1000		0.1424			126.3				
134	Graph	2	x	sonic resonance		1075		0.1424			125.1				
134	Graph	2	x	sonic resonance		1170		0.1424			122.7				
134	Graph	2	x	sonic resonance		1250		0.1424			121.5				
134	Graph	2	x	sonic resonance		1330		0.1424			120.2				
134	Graph	2	x	sonic resonance		1400		0.1424			118.0				
134	Graph	2	x	sonic resonance		25		0.1424				57.4			
134	Graph	2	x	sonic resonance		90		0.1424				57.2			
134	Graph	2	x	sonic resonance		145		0.1424				57.0			
134	Graph	2	x	sonic resonance		168		0.1424				56.9			
134	Graph	2	x	sonic resonance		238		0.1424				55.7			
134	Graph	2	x	sonic resonance		301		0.1424				55.5			
134	Graph	2	x	sonic resonance		363		0.1424				55.3			
134	Graph	2	x	sonic resonance		418		0.1424				55.2			
134	Graph	2	x	sonic resonance		488		0.1424				54.0			
134	Graph	2	x	sonic resonance		558		0.1424				52.7			
134	Graph	2	x	sonic resonance		629		0.1424				52.5			
134	Graph	2	x	sonic resonance		699		0.1424				52.3			
134	Graph	2	x	sonic resonance		769		0.1424				52.1			
134	Graph	2	x	sonic resonance		832		0.1424				51.9			
134	Graph	2	x	sonic resonance		879		0.1424				50.8			
134	Graph	2	x	sonic resonance		941		0.1424				50.6			
134	Graph	2	x	sonic resonance		1000		0.1424				50.4			
134	Graph	2	x	sonic resonance		1075		0.1424				49.2			
134	Graph	2	x	sonic resonance		1170		0.1424				48.9			

Sc_2O_3 { scandium oxide, scandia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
134	Graph	2	x	sonic resonance		1250		0.1424				48.7			
134	Graph	2	x	sonic resonance		1330		0.1424				46.4			
134	Graph	2	x	sonic resonance		1400		0.1424				46.1			

9.29 SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

M_r / (g mol^{-1}) = 60.084	Temperature range / (°C) = -200 to 1650	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a



SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }															
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
135	Graph	27	x	sonic velocity		-196			5.832						
135	Graph	27	x	sonic velocity		-181			5.838						
135	Graph	27	x	sonic velocity		-171			5.841						
135	Graph	27	x	sonic velocity		-158			5.846						
135	Graph	27	x	sonic velocity		-150			5.850						
135	Graph	27	x	sonic velocity		-124			5.865						
135	Graph	27	x	sonic velocity		-112			5.872						
135	Graph	27	x	sonic velocity		-94			5.887						
135	Graph	27	x	sonic velocity		-84			5.897						
135	Graph	27	x	sonic velocity		-73			5.904						
135	Graph	27	x	sonic velocity		-79			5.898						
135	Graph	27	x	sonic velocity		-62			5.909						
135	Graph	27	x	sonic velocity		-50			5.917						
135	Graph	27	x	sonic velocity		-34			5.928						
135	Graph	27	x	sonic velocity		-21			5.937						
135	Graph	27	x	sonic velocity		-4			5.949						
135	Graph	27	x	sonic velocity		8			5.960						
135	Graph	27	x	sonic velocity		24	2.203		5.968						
135	Graph	27	x	sonic velocity		26			5.970						
135	Graph	28	x	sonic velocity		-197				3.712					
135	Graph	28	x	sonic velocity		-177				3.714					
135	Graph	28	x	sonic velocity		-162				3.716					
135	Graph	28	x	sonic velocity		-157				3.716					
135	Graph	28	x	sonic velocity		-135				3.721					
135	Graph	28	x	sonic velocity		-120				3.724					
135	Graph	23	x	sonic velocity		-99				3.731					
135	Graph	23	x	sonic velocity		-80				3.736					
135	Graph	23	x	sonic velocity		-195				3.712					
135	Graph	23	x	sonic velocity		-76				3.736					
135	Graph	23	x	sonic velocity		-76				3.737					
135	Graph	23	x	sonic velocity		-44				3.745					
135	Graph	23	x	sonic velocity		1				3.757					

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
135	Graph	28	x	sonic velocity		30	2.203			3.766					
135	Graph	29	s	sonic velocity		-200					70.37				
135	Graph	29	s	sonic velocity		-175					70.52				
135	Graph	29	s	sonic velocity		-150					70.75				
135	Graph	29	s	sonic velocity		-125					71.03				
135	Graph	29	s	sonic velocity		-100					71.34				
135	Graph	29	s	sonic velocity		-75					71.67				
135	Graph	29	s	sonic velocity		-50					72				
135	Graph	29	s	sonic velocity		-25					72.35				
135	Graph	29	s	sonic velocity		0					72.7				
135	Graph	29	s	sonic velocity		25	2.203				73.06				
135	Graph	29	s	sonic velocity		50					73.43				
135	Graph	30	s	sonic velocity		-200						30.34			
135	Graph	30	s	sonic velocity		-175						30.39			
135	Graph	30	s	sonic velocity		-150						30.46			
135	Graph	30	s	sonic velocity		-125						30.55			
135	Graph	30	s	sonic velocity		-100						30.65			
135	Graph	30	s	sonic velocity		-75						30.75			
135	Graph	30	s	sonic velocity		-50						30.87			
135	Graph	30	s	sonic velocity		-25						30.98			
135	Graph	30	s	sonic velocity		0						31.1			
135	Graph	30	s	sonic velocity		25	2.203					31.23			
135	Graph	30	s	sonic velocity		50						31.35			
136	Table	I	x	sonic resonance		23	2.202				72.94	31.39		0.162	
136	Table	I	x	sonic resonance		23	2.201				72.90	31.38		0.162	
136	Table	I	x	sonic resonance		23	2.200				73.07	31.35		0.165	
137	Graph	9	x	sonic resonance		23	2.20				72.9	31.4		0.165	
137	Graph	9	x	sonic resonance		100					73.7	31.7		0.170	
137	Graph	9	x	sonic resonance		200					74.7	31.9		0.175	
137	Graph	9	x	sonic resonance		300					75.8	32.2		0.179	
137	Graph	9	x	sonic resonance		400					76.9	32.6		0.183	

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
137	Graph	9	x	sonic resonance		500					77.5	32.9		0.185	
137	Graph	9	x	sonic resonance		600						33.1		0.189	
137	Graph	9	x	sonic resonance		700					79.9	33.3		0.193	
137	Graph	9	x	sonic resonance		800					80.7	33.6		0.197	
137	Graph	9	x	sonic resonance		900					81.6	34.0		0.199	
138	Graph	2	x	sonic velocity		22			5.968						
138	Graph	2	x	sonic velocity		25	2.203		5.970						
138	Graph	2	x	sonic velocity		32			5.974						
138	Graph	2	x	sonic velocity		51			5.988						
138	Graph	2	x	sonic velocity		70			6.000						
138	Graph	2	x	sonic velocity		94			6.013						
138	Graph	2	x	sonic velocity		99			6.019						
138	Graph	2	x	sonic velocity		116			6.027						
138	Graph	2	x	sonic velocity		121			6.031						
138	Graph	2	x	sonic velocity		130			6.037						
138	Graph	2	x	sonic velocity		162			6.054						
138	Graph	2	x	sonic velocity		176			6.062						
138	Graph	2	x	sonic velocity		176			6.062						
138	Graph	2	x	sonic velocity		198			6.072						
138	Graph	2	x	sonic velocity		222			6.090						
138	Graph	2	x	sonic velocity		246			6.099						
138	Graph	2	x	sonic velocity		198			6.070						
138	Graph	2	x	sonic velocity		239			6.097						
138	Graph	2	x	sonic velocity		263			6.109						
138	Graph	2	x	sonic velocity		273			6.113						
138	Graph	2	x	sonic velocity		283			6.119						
138	Graph	2	x	sonic velocity		309			6.133						
138	Graph	2	x	sonic velocity		317			6.135						
138	Graph	2	x	sonic velocity		329			6.141						
138	Graph	2	x	sonic velocity		336			6.145						
138	Graph	2	x	sonic velocity		348			6.149						
138	Graph	2	x	sonic velocity		355			6.154						

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
138	Graph	2	x	sonic velocity		365			6.156						
138	Graph	2	x	sonic velocity		367			6.162						
138	Graph	2	x	sonic velocity		384			6.168						
138	Graph	2	x	sonic velocity		392			6.168						
138	Graph	2	x	sonic velocity		391			6.170						
138	Graph	2	x	sonic velocity		394			6.176						
138	Graph	2	x	sonic velocity		411			6.180						
138	Graph	2	x	sonic velocity		416			6.184						
138	Graph	2	x	sonic velocity		423			6.184						
138	Graph	2	x	sonic velocity		420			6.186						
138	Graph	2	x	sonic velocity		428			6.188						
138	Graph	2	x	sonic velocity		433			6.190						
138	Graph	2	x	sonic velocity		437			6.190						
138	Graph	2	x	sonic velocity		442			6.192						
138	Graph	2	x	sonic velocity		447			6.190						
138	Graph	2	x	sonic velocity		462			6.196						
138	Graph	2	x	sonic velocity		459			6.200						
138	Graph	2	x	sonic velocity		467			6.200						
138	Graph	2	x	sonic velocity		466			6.204						
138	Graph	2	x	sonic velocity		466			6.207						
138	Graph	2	x	sonic velocity		474			6.209						
138	Graph	2	x	sonic velocity		479			6.208						
138	Graph	2	x	sonic velocity		486			6.211						
138	Graph	2	x	sonic velocity		496			6.217						
138	Graph	2	x	sonic velocity		498			6.217						
138	Graph	2	x	sonic velocity		135			6.039						
138	Graph	2	x	sonic velocity		157			6.052						
138	Graph	2	x	sonic velocity		191			6.070						
138	Graph	2	x	sonic velocity		225			6.089						
138	Graph	2	x	sonic velocity		244			6.094						
138	Graph	2	x	sonic velocity		250			6.104						
138	Graph	9	x	sonic velocity		25				3.760					
138	Graph	9	x	sonic velocity		34				3.762					

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
138	Graph	9	x	sonic velocity		46				3.765					
138	Graph	9	x	sonic velocity		54				3.769					
138	Graph	9	x	sonic velocity		66				3.772					
138	Graph	9	x	sonic velocity		77				3.774					
138	Graph	9	x	sonic velocity		82				3.776					
138	Graph	9	x	sonic velocity		126				3.787					
138	Graph	9	x	sonic velocity		167				3.797					
138	Graph	9	x	sonic velocity		212				3.808					
138	Graph	9	x	sonic velocity		218				3.809					
138	Graph	9	x	sonic velocity		225				3.810					
138	Graph	2,9	s	sonic velocity		25	2.203		5.971	3.760	72.97	31.14	37.02	0.171	
138	Graph	2,9	s	sonic velocity		50			5.987	3.767	73.29	31.26	37.28	0.172	
138	Graph	2,9	s	sonic velocity		75			6.002	3.774	73.61	31.38	37.53	0.173	
138	Graph	2,9	s	sonic velocity		100			6.017	3.781	73.93	31.49	37.79	0.174	
138	Graph	2,9	s	sonic velocity		125			6.032	3.787	74.23	31.59	38.04	0.175	
138	Graph	2,9	s	sonic velocity		150			6.047	3.793	74.53	31.70	38.29	0.176	
138	Graph	2,9	s	sonic velocity		175			6.061	3.799	74.81	31.80	38.53	0.176	
138	Graph	2,9	s	sonic velocity		200			6.075	3.805	75.09	31.89	38.78	0.177	
138	Graph	2,9	s	sonic velocity		225			6.089	3.810	75.36	31.99	39.02	0.178	
138	Graph	2,9	s	sonic velocity		250			6.102	3.816	75.63	32.07	39.26	0.179	
138	Graph	2,9	s	sonic velocity		275			6.115	3.821	75.88	32.16	39.49	0.180	
138	Graph	2,9	s	sonic velocity		300			6.127	3.825	76.12	32.24	39.73	0.181	
138	Graph	2,9	s	sonic velocity		325			6.140	3.830	76.36	32.31	39.96	0.181	
138	Graph	2,9	s	sonic velocity		350			6.152	3.834	76.59	32.39	40.18	0.182	
138	Graph	2,9	s	sonic velocity		375			6.163	3.838	76.81	32.46	40.41	0.183	
138	Graph	2,9	s	sonic velocity		400			6.175	3.842	77.02	32.52	40.63	0.184	
138	Graph	2,9	s	sonic velocity		425			6.186	3.846	77.22	32.58	40.85	0.185	
138	Graph	2,9	s	sonic velocity		450			6.196	3.849	77.41	32.64	41.06	0.186	
138	Graph	2,9	s	sonic velocity		475			6.207	3.852	77.59	32.69	41.28	0.187	
138	Graph	2,9	s	sonic velocity		500			6.217	3.855	77.77	32.74	41.49	0.188	
139	Graph	5	x	ultrasonic velocity		25								0.163	
139	Graph	5	x	ultrasonic velocity		100								0.160	

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
139	Graph	5	x	ultrasonic velocity		200								0.162	
139	Graph	5	x	ultrasonic velocity		300								0.162	
139	Graph	5	x	ultrasonic velocity		400								0.162	
139	Graph	5	x	ultrasonic velocity		500								0.166	
139	Graph	5	x	ultrasonic velocity		600								0.168	
139	Graph	5	x	ultrasonic velocity		700								0.170	
139	Graph	5	x	ultrasonic velocity		800								0.173	
139	Graph	5	x	ultrasonic velocity		900								0.175	
139	Graph	5	x	ultrasonic velocity		1000								0.181	
139	Graph	5	x	ultrasonic velocity		1050								0.181	
139	Graph	7	x	ultrasonic velocity		25					73.4	31.5			
139	Graph	7	x	ultrasonic velocity		100						33.1			
139	Graph	7	x	ultrasonic velocity		200						31.9			
139	Graph	7	x	ultrasonic velocity		300						33.5			
139	Graph	7	x	ultrasonic velocity		400						33.5			
139	Graph	7	x	ultrasonic velocity		500						33.1			
139	Graph	7	x	ultrasonic velocity		550					78.3				
139	Graph	7	x	ultrasonic velocity		570					78.3				
139	Graph	7	x	ultrasonic velocity		600					78.7	33.9			
139	Graph	7	x	ultrasonic velocity		700						33.9			
139	Graph	7	x	ultrasonic velocity		720					79.1				
139	Graph	7	x	ultrasonic velocity		800					79.1	33.9			
139	Graph	7	x	ultrasonic velocity		900						33.9			
139	Graph	7	x	ultrasonic velocity		920					79.9				
139	Graph	7	x	ultrasonic velocity		930					79.9				
139	Graph	7	x	ultrasonic velocity		1000						34.3			
139	Graph	7	x	ultrasonic velocity		1050					80.3	33.9			
140	Graph	3	x	sonic velocity		300					73.6	31.4	37.4		
140	Graph	3	x	sonic velocity		450					75.1	32.0	38.5		
140	Graph	3	x	sonic velocity		600					76.6	32.5	39.9		
140	Graph	3	x	sonic velocity		750					77.6	32.8	40.8		
140	Graph	3	x	sonic velocity		900					78.6	33.1	41.9		

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
140	Graph	3	x	sonic velocity		1050					79.3	33.3	42.6		
140	Graph	3	x	sonic velocity		1200					79.6	33.4	42.8		
140	Graph	3	x	sonic velocity		1350					80.3	33.7	43.6		
140	Graph	3	x	sonic velocity		1500					80.9	33.8	44.2		
140	Graph	3	x	sonic velocity		1650					81.5	34.0	44.8		
140	Graph	4	x	sonic velocity		300								0.172	
140	Graph	4	x	sonic velocity		450								0.175	
140	Graph	4	x	sonic velocity		600								0.180	
140	Graph	4	x	sonic velocity		750								0.183	
140	Graph	4	x	sonic velocity		900								0.187	
140	Graph	4	x	sonic velocity		1050								0.190	
140	Graph	4	x	sonic velocity		1200								0.190	
140	Graph	4	x	sonic velocity		1350								0.193	
140	Graph	4	x	sonic velocity		1500								0.195	
140	Graph	4	x	sonic velocity		1650								0.197	
141	Graph		x	sonic velocity		-203			5.78	3.71	70.3	30.6	33.5	0.149	
141	Graph		s	sonic velocity		-178			5.80	3.71	70.5	30.6	33.9	0.152	
141	Graph		s	sonic velocity		-153			5.81	3.72	70.8	30.7	34.3	0.153	
141	Graph		s	sonic velocity		-128			5.83	3.72	71.0	30.7	34.6	0.156	
141	Graph		s	sonic velocity		-103			5.84	3.72	71.2	30.7	35.0	0.160	
141	Graph		s	sonic velocity		-78			5.86	3.72	71.5	30.8	35.4	0.161	
141	Graph		s	sonic velocity		-53			5.88	3.72	71.7	30.8	35.8	0.164	
141	Graph		s	sonic velocity		-28			5.89	3.72	71.9	30.8	36.1	0.167	
141	Graph		s	sonic velocity		-3			5.91	3.73	72.2	30.9	36.5	0.168	
141	Graph		s	sonic velocity		22	2.2199		5.93	3.73	72.4	30.9	36.9	0.172	
141	Graph		s	sonic velocity		47			5.94	3.73	72.6	30.9	37.3	0.175	
141	Graph		s	sonic velocity		72			5.96	3.74	72.9	31.0	37.6	0.176	
141	Graph		x	sonic velocity		97			5.98	3.74	73.1	31.0	38.0	0.179	
141	Graph		s	sonic velocity		122			5.99	3.74	73.3	31.0	38.4	0.182	
142	Table	II	x	dynamic resonance		23	2.2012				72.70	31.06			3
142	Table	III	x	dynamic resonance		23	2.2017				72.90	31.10			4

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
142	Table	III	x	dynamic resonance		23	2.2030				73.15	31.19			1
142	Table	III	x	dynamic resonance		23	2.2026				73.00	31.17			2
142	Table	III	x	dynamic resonance		23	2.2027				72.82	31.27			5
142	Table	III	x	dynamic resonance		23	2.2027				72.98	31.28			6
142	Graph	1	x	dynamic resonance		23	2.2030				73.15				1
142	Graph	1	x	dynamic resonance		114					74.22				1
142	Graph	1	x	dynamic resonance		120					74.22				1
142	Graph	1	x	dynamic resonance		152					74.81				1
142	Graph	1	x	dynamic resonance		196					75.22				1
142	Graph	1	x	dynamic resonance		208					75.22				1
142	Graph	1	x	dynamic resonance		304					76.41				1
142	Graph	1	x	dynamic resonance		392					77.06				1
142	Graph	1	x	dynamic resonance		405					77.41				1
142	Graph	1	x	dynamic resonance		512					78.30				1
142	Graph	1	x	dynamic resonance		562					78.66				1
142	Graph	1	x	dynamic resonance		593					78.89				1
142	Graph	1	x	dynamic resonance		594					79.01				1
142	Graph	1	x	dynamic resonance		706					79.60				1
142	Graph	1	x	dynamic resonance		737					79.78				1
142	Graph	1	x	dynamic resonance		806					80.13				1
142	Graph	1	x	dynamic resonance		844					80.48				1
142	Graph	1	x	dynamic resonance		900					80.71				1
142	Graph	1	x	dynamic resonance		1005					81.12				1
142	Graph	1	x	dynamic resonance		1092					81.42				1
142	Graph	1	x	dynamic resonance		1173					81.64				1
142	Graph	1	x	dynamic resonance		1228					81.64				1
142	Graph	1	x	dynamic resonance		1240					81.64				1
142	Graph	1	x	dynamic resonance		23	2.2026				73.00				2
142	Graph	1	x	dynamic resonance		94					73.82				2
142	Graph	1	x	dynamic resonance		323					76.43				2
142	Graph	1	x	dynamic resonance		499					78.02				2
142	Graph	1	x	dynamic resonance		599					78.67				2
142	Graph	1	x	dynamic resonance		656					79.08				2

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
142	Graph	1	x	dynamic resonance		706					79.37				2
142	Graph	1	x	dynamic resonance		731					79.49				2
142	Graph	1	x	dynamic resonance		799					79.91				2
142	Graph	1	x	dynamic resonance		905					80.37				2
142	Graph	1	x	dynamic resonance		1005					80.78				2
142	Graph	1	x	dynamic resonance		1105					81.31				2
142	Graph	1	x	dynamic resonance		1191					81.42				2
142	Graph	1	x	dynamic resonance		1259					81.47				2
142	Graph	1	x	dynamic resonance		23	2.2012				72.70				3
142	Graph	1	x	dynamic resonance		96					73.87				3
142	Graph	1	x	dynamic resonance		172					74.68				3
142	Graph	1	x	dynamic resonance		203					74.92				3
142	Graph	1	x	dynamic resonance		405					76.89				3
142	Graph	1	x	dynamic resonance		418					76.95				3
142	Graph	1	x	dynamic resonance		513					77.83				3
142	Graph	1	x	dynamic resonance		600					78.46				3
142	Graph	1	x	dynamic resonance		607					78.57				3
142	Graph	1	x	dynamic resonance		663					78.86				3
142	Graph	1	x	dynamic resonance		701					79.21				3
142	Graph	1	x	dynamic resonance		819					79.79				3
142	Graph	1	x	dynamic resonance		901					80.42				3
142	Graph	1	x	dynamic resonance		931					80.48				3
142	Graph	1	x	dynamic resonance		969					80.65				3
142	Graph	1	x	dynamic resonance		981					80.65				3
142	Graph	1	x	dynamic resonance		1012					80.76				3
142	Graph	1	x	dynamic resonance		1024					80.70				3
142	Graph	1	x	dynamic resonance		1073					80.69				3
142	Graph	1	x	dynamic resonance		1097					80.63				3
142	Graph	1	x	dynamic resonance		1122					80.68				3
142	Graph	1	x	dynamic resonance		1116					80.69				3
142	Graph	1	x	dynamic resonance		23	2.2017				72.90				4
142	Graph	1	x	dynamic resonance		165					74.59				4
142	Graph	1	x	dynamic resonance		209					75.18				4

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
142	Graph	1	x	dynamic resonance		317					76.23				4
142	Graph	1	x	dynamic resonance		418					77.28				4
142	Graph	1	x	dynamic resonance		500					77.98				4
142	Graph	1	x	dynamic resonance		620					78.97				4
142	Graph	1	x	dynamic resonance		719					79.42				4
142	Graph	1	x	dynamic resonance		813					80.12				4
142	Graph	1	x	dynamic resonance		900					80.47				4
142	Graph	1	x	dynamic resonance		962					80.88				4
142	Graph	1	x	dynamic resonance		1036					81.04				4
142	Graph	1	x	dynamic resonance		1098					81.03				4
142	Graph	1	x	dynamic resonance		1134					80.90				4
142	Graph	1	x	dynamic resonance		102					74.13				4
142	Graph	1	x	dynamic resonance		305					76.29				4
142	Graph	1	x	dynamic resonance		406					77.40				4
142	Graph	1	x	dynamic resonance		519					78.16				4
142	Graph	1	x	dynamic resonance		625					78.85				4
142	Graph	1	x	dynamic resonance		726					79.55				4
142	Graph	1	x	dynamic resonance		814					80.24				4
142	Graph	1	x	dynamic resonance		863					80.53				4
142	Graph	1	x	dynamic resonance		1079					81.04				4
142	Graph	1	x	dynamic resonance		23	2.2027				72.82				5
142	Graph	1	x	dynamic resonance		76					73.46				5
142	Graph	1	x	dynamic resonance		165					74.76				5
142	Graph	1	x	dynamic resonance		273					76.05				5
142	Graph	1	x	dynamic resonance		405					77.23				5
142	Graph	1	x	dynamic resonance		437					77.58				5
142	Graph	1	x	dynamic resonance		506					77.98				5
142	Graph	1	x	dynamic resonance		569					78.51				5
142	Graph	1	x	dynamic resonance		600					78.75				5
142	Graph	1	x	dynamic resonance		694					79.39				5
142	Graph	1	x	dynamic resonance		819					80.14				5
142	Graph	1	x	dynamic resonance		913					80.60				5
142	Graph	1	x	dynamic resonance		925					80.72				5

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
142	Graph	1	x	dynamic resonance		937					80.72				5
142	Graph	1	x	dynamic resonance		994					81.13				5
142	Graph	1	x	dynamic resonance		1074					81.35				5
142	Graph	1	x	dynamic resonance		1099					81.35				5
142	Graph	1	x	dynamic resonance		1118					81.46				5
142	Graph	1	x	dynamic resonance		1185					81.40				5
142	Graph	1	x	dynamic resonance		1198					81.51				5
142	Graph	1	x	dynamic resonance		1222					81.45				5
142	Graph	1	x	dynamic resonance		1247					81.38				5
142	Graph	1	x	dynamic resonance		1259					81.33				5
142	Graph	1	x	dynamic resonance		23	2.2027				72.98				6
142	Graph	1	x	dynamic resonance		101					74.04				6
142	Graph	1	x	dynamic resonance		152					74.75				6
142	Graph	1	x	dynamic resonance		203					75.28				6
142	Graph	1	x	dynamic resonance		298					76.40				6
142	Graph	1	x	dynamic resonance		405					77.34				6
142	Graph	1	x	dynamic resonance		606					78.98				6
142	Graph	1	x	dynamic resonance		675					79.45				6
142	Graph	1	x	dynamic resonance		688					79.50				6
142	Graph	1	x	dynamic resonance		806					80.20				6
142	Graph	1	x	dynamic resonance		894					80.66				6
142	Graph	1	x	dynamic resonance		987					81.18				6
142	Graph	1	x	dynamic resonance		1198					81.69				6
142	Graph	1	x	dynamic resonance		1229					81.63				6
142	Graph	1	x	dynamic resonance		23	2.201				72.94				7
142	Graph	1	x	dynamic resonance		90					73.86				7
142	Graph	1	x	dynamic resonance		147					74.49				7
142	Graph	1	x	dynamic resonance		199					75.13				7
142	Graph	1	x	dynamic resonance		289					76.16				7
142	Graph	1	x	dynamic resonance		308					76.22				7
142	Graph	1	x	dynamic resonance		404					77.19				7
142	Graph	1	x	dynamic resonance		473					77.76				7
142	Graph	1	x	dynamic resonance		601					79.09				7

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
142	Graph	1	x	dynamic resonance		664					79.37				7
142	Graph	1	x	dynamic resonance		697					79.83				7
142	Graph	1	x	dynamic resonance		784					80.04				7
142	Graph	1	x	dynamic resonance		803					80.22				7
142	Graph	1	x	dynamic resonance		828					80.21				7
142	Graph	1	x	dynamic resonance		872					80.61				7
142	Graph	1	x	dynamic resonance		897					80.66				7
142	Graph	1	x	dynamic resonance		1004					81.06				7
142	Graph	1	x	dynamic resonance		1023					81.34				7
142	Graph	1	x	dynamic resonance		1073					81.39				7
142	Graph	1	x	dynamic resonance		1092					81.50				7
142	Graph	1	x	dynamic resonance		1160					81.67				7
142	Graph	1	x	dynamic resonance		1197					81.37				7
142	Graph	1	x	dynamic resonance		1221					81.36				7
142	Graph	1	x	dynamic resonance		1264					81.18				7
142	Graph	1	x	dynamic resonance		167					74.72				7
142	Graph	1	x	dynamic resonance		199					75.13				7
142	Graph	1	x	dynamic resonance		326					76.22				7
142	Graph	1	x	dynamic resonance		448					77.54				7
142	Graph	1	x	dynamic resonance		505					78.05				7
142	Graph	1	x	dynamic resonance		620					79.20				7
142	Graph	1	x	dynamic resonance		703					79.77				7
142	Graph	1	x	dynamic resonance		809					80.21				7
142	Graph	1	x	dynamic resonance		905					81.01				7
142	Graph	1	x	dynamic resonance		1005					81.41				7
142	Graph	1	x	dynamic resonance		1105					81.74				7
142	Graph	1	x	dynamic resonance		1142					81.79				7
142	Graph	1	x	dynamic resonance		1204					81.78				7
142	Graph	1	x	dynamic resonance		1259					81.65				7
142	Graph	1	x	dynamic resonance		23	2.2030					31.19			1
142	Graph	1	x	dynamic resonance		100						31.49			1
142	Graph	1	x	dynamic resonance		125						31.57			1
142	Graph	1	x	dynamic resonance		151						31.75			1

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
142	Graph	1	x	dynamic resonance		195						31.92			1
142	Graph	1	x	dynamic resonance		403						32.63			1
142	Graph	1	x	dynamic resonance		509						32.90			1
142	Graph	1	x	dynamic resonance		565						33.08			1
142	Graph	1	x	dynamic resonance		702						33.33			1
142	Graph	1	x	dynamic resonance		728						33.48			1
142	Graph	1	x	dynamic resonance		747						33.53			1
142	Graph	1	x	dynamic resonance		802						33.53			1
142	Graph	1	x	dynamic resonance		995						33.95			1
142	Graph	1	x	dynamic resonance		989						34.00			1
142	Graph	1	x	dynamic resonance		1101						34.08			1
142	Graph	1	x	dynamic resonance		1163						34.17			1
142	Graph	1	x	dynamic resonance		1194						34.20			1
142	Graph	1	x	dynamic resonance		1254						34.02			1
142	Graph	1	x	dynamic resonance		23	2.2026					31.17			2
142	Graph	1	x	dynamic resonance		94						31.47			2
142	Graph	1	x	dynamic resonance		200						31.75			2
142	Graph	1	x	dynamic resonance		328						32.43			2
142	Graph	1	x	dynamic resonance		515						32.88			2
142	Graph	1	x	dynamic resonance		609						33.23			2
142	Graph	1	x	dynamic resonance		777						33.45			2
142	Graph	1	x	dynamic resonance		909						33.86			2
142	Graph	1	x	dynamic resonance		1007						33.90			2
142	Graph	1	x	dynamic resonance		1107						34.08			2
142	Graph	1	x	dynamic resonance		1205						34.05			2
142	Graph	1	x	dynamic resonance		23	2.2012					31.06			3
142	Graph	1	x	dynamic resonance		94						31.38			3
142	Graph	1	x	dynamic resonance		202						31.83			3
142	Graph	1	x	dynamic resonance		309						32.23			3
142	Graph	1	x	dynamic resonance		397						32.50			3
142	Graph	1	x	dynamic resonance		415						32.55			3
142	Graph	1	x	dynamic resonance		503						32.82			3
142	Graph	1	x	dynamic resonance		516						32.87			3

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
142	Graph	1	x	dynamic resonance		603						33.04			3
142	Graph	1	x	dynamic resonance		659						33.16			3
142	Graph	1	x	dynamic resonance		709						33.26			3
142	Graph	1	x	dynamic resonance		808						33.46			3
142	Graph	1	x	dynamic resonance		932						33.73			3
142	Graph	1	x	dynamic resonance		975						33.72			3
142	Graph	1	x	dynamic resonance		1018						33.75			3
142	Graph	1	x	dynamic resonance		1067						33.77			3
142	Graph	1	x	dynamic resonance		23	2.2017					31.10			4
142	Graph	1	x	dynamic resonance		158						31.70			4
142	Graph	1	x	dynamic resonance		176						31.75			4
142	Graph	1	x	dynamic resonance		214						31.90			4
142	Graph	1	x	dynamic resonance		321						32.29			4
142	Graph	1	x	dynamic resonance		403						32.54			4
142	Graph	1	x	dynamic resonance		516						32.91			4
142	Graph	1	x	dynamic resonance		622						33.13			4
142	Graph	1	x	dynamic resonance		821						33.55			4
142	Graph	1	x	dynamic resonance		895						33.72			4
142	Graph	1	x	dynamic resonance		957						33.79			4
142	Graph	1	x	dynamic resonance		1043						33.82			4
142	Graph	1	x	dynamic resonance		1080						33.86			4
142	Graph	1	x	dynamic resonance		1098						33.81			4
142	Graph	1	x	dynamic resonance		1116						33.81			4
142	Graph	1	x	dynamic resonance		409						32.59			4
142	Graph	1	x	dynamic resonance		616						33.18			4
142	Graph	1	x	dynamic resonance		709						33.38			4
142	Graph	1	x	dynamic resonance		803						33.60			4
142	Graph	1	x	dynamic resonance		859						33.72			4
142	Graph	1	x	dynamic resonance		1006						33.84			4
142	Graph	1	x	dynamic resonance		1025						33.86			4
142	Graph	1	x	dynamic resonance		23	2.2027					31.27			5
142	Graph	1	x	dynamic resonance		100						31.57			5
142	Graph	1	x	dynamic resonance		170						31.92			5

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
142	Graph	1	x	dynamic resonance		214						32.05			5
142	Graph	1	x	dynamic resonance		271						32.33			5
142	Graph	1	x	dynamic resonance		303						32.48			5
142	Graph	1	x	dynamic resonance		415						32.75			5
142	Graph	1	x	dynamic resonance		440						32.78			5
142	Graph	1	x	dynamic resonance		509						33.08			5
142	Graph	1	x	dynamic resonance		553						33.18			5
142	Graph	1	x	dynamic resonance		572						33.18			5
142	Graph	1	x	dynamic resonance		591						33.30			5
142	Graph	1	x	dynamic resonance		672						33.45			5
142	Graph	1	x	dynamic resonance		690						33.45			5
142	Graph	1	x	dynamic resonance		802						33.70			5
142	Graph	1	x	dynamic resonance		902						33.90			5
142	Graph	1	x	dynamic resonance		939						33.92			5
142	Graph	1	x	dynamic resonance		989						34.04			5
142	Graph	1	x	dynamic resonance		1070						34.12			5
142	Graph	1	x	dynamic resonance		1094						34.17			5
142	Graph	1	x	dynamic resonance		1186						34.11			5
142	Graph	1	x	dynamic resonance		1193						34.21			5
142	Graph	1	x	dynamic resonance		1241						34.00			5
142	Graph	1	x	dynamic resonance		23	2.2027					31.28			6
142	Graph	1	x	dynamic resonance		69						31.51			6
142	Graph	1	x	dynamic resonance		151						31.81			6
142	Graph	1	x	dynamic resonance		214						32.06			6
142	Graph	1	x	dynamic resonance		302						32.44			6
142	Graph	1	x	dynamic resonance		446						32.76			6
142	Graph	1	x	dynamic resonance		503						33.01			6
142	Graph	1	x	dynamic resonance		566						33.21			6
142	Graph	1	x	dynamic resonance		616						33.36			6
142	Graph	1	x	dynamic resonance		709						33.56			6
142	Graph	1	x	dynamic resonance		809						33.76			6
142	Graph	1	x	dynamic resonance		890						33.96			6
142	Graph	1	x	dynamic resonance		983						34.00			6

SiO_2 { silicon dioxide, silica, fused silica, fused quartz, vitreous silica }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
142	Graph	1	x	dynamic resonance		1082						34.13			6
142	Graph	1	x	dynamic resonance		1107						34.23			6
142	Graph	1	x	dynamic resonance		1144						34.20			6
142	Graph	1	x	dynamic resonance		1211						34.17			6
142	Graph	1	x	dynamic resonance		23	2.201					31.38			7

Footnotes:

1: Source A, specimen c, density at 23 °C = 2.2030 g/cm^3

2: Source A, specimen d, density at 23 °C = 2.2026 g/cm^3

3: Source C, specimen a, density at 23 °C = 2.2012 g/cm^3

4: Source C, specimen b, density at 23 °C = 2.2017 g/cm^3

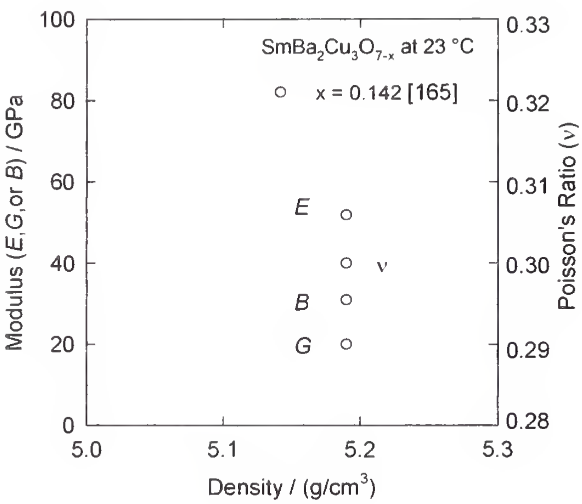
5: Source G, specimen e, density at 23 °C = 2.2027 g/cm^3

6: Source G, specimen f, density at 23 °C = 2.2027 g/cm^3

7: Source X, specimen 1, density at 23 °C = 2.201 g/cm^3

9.30 $SmBa_2Cu_3O_{7-x}$ { Sm:123 }

M_r / (g mol^{-1}) =727.659-15.999x	Temperature range / (°C) = 23 to 23	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a



$SmBa_2Cu_3O_{7-x}$ { Sm:123 }

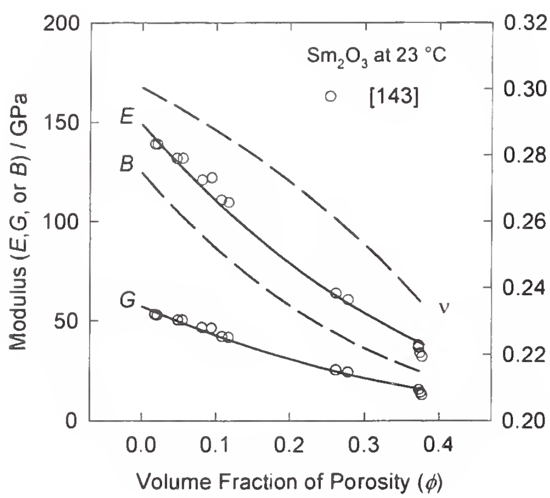
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
165	Table	3	x	ultrasonic velocity		23	5.190		3.658	1.962	52.0	20.0		0.30	1

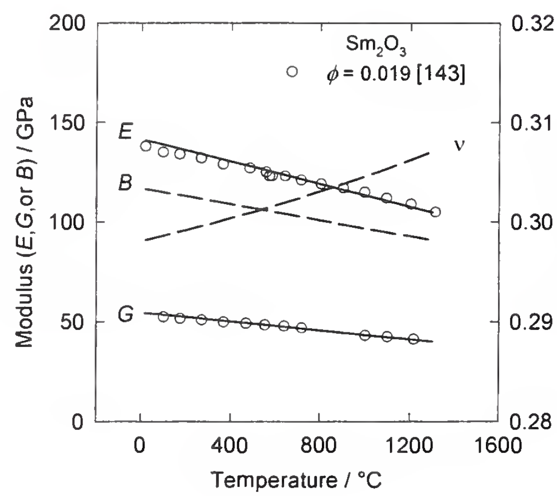
Footnotes:

1: $SmBa_2Cu_3O_{6.858}$ Authors reported ρ_{xtal} = 6.718 g/cm³, but their lattice parameters yield 6.85 g/cm³ for Sm:123 with $O_{6.858}$.

9.31 Sm_2O_3 {samarium oxide, samaria }

M_r / (g mol^{-1}) = 348.718	Temperature range / (°C) = 0 to 1300	
ρ_{theo} / (g cm^{-3}) = 7.748	Porosity range = 0 to 0.38	
	E_o / (GPa) = 150	B_o / (GPa) = 125
	a / (10^{-4}°C) = 2.00	b / (10^{-4}°C) = 1.73
	n = 2.85	m = 3.45





Sm_2O_3 { samarium oxide, samaria }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
143	Graph	1	x	sonic resonance		23		0.018			139				
143	Graph	1	x	sonic resonance		23		0.021			138.9				
143	Graph	1	x	sonic resonance		23		0.047			131.8				
143	Graph	1	x	sonic resonance		23		0.055			131.8				
143	Graph	1	x	sonic resonance		23		0.081			120.8				
143	Graph	1	x	sonic resonance		23		0.094			122.0				
143	Graph	1	x	sonic resonance		23		0.107			110.8				
143	Graph	1	x	sonic resonance		23		0.117			109.5				
143	Graph	1	x	sonic resonance		23		0.262			63.9				
143	Graph	1	x	sonic resonance		23		0.278			60.6				
143	Graph	1	x	sonic resonance		23		0.372			37.9				
143	Graph	1	x	sonic resonance		23		0.372			36.9				
143	Graph	1	x	sonic resonance		23		0.374			34.0				
143	Graph	1	x	sonic resonance		23		0.377			32.1				
143	Graph	2	x	sonic resonance		19		0.019			138				
143	Graph	2	x	sonic resonance		97		0.019			135				
143	Graph	2	x	sonic resonance		171		0.019			134				
143	Graph	2	x	sonic resonance		266		0.019			132				
143	Graph	2	x	sonic resonance		363		0.019			129				
143	Graph	2	x	sonic resonance		467		0.019			127				
143	Graph	2	x	sonic resonance		555		0.019			125				
143	Graph	2	x	sonic resonance		640		0.019			123				
143	Graph	2	x	sonic resonance		713		0.019			121				
143	Graph	2	x	sonic resonance		804		0.019			119				
143	Graph	2	x	sonic resonance		903		0.019			117				
143	Graph	2	x	sonic resonance		998		0.019			115				
143	Graph	2	x	sonic resonance		1094		0.019			112				
143	Graph	2	x	sonic resonance		1203		0.019			109				
143	Graph	2	x	sonic resonance		1312		0.019			105				
143	Graph	1	x	sonic resonance		23		0.018				53.1			
143	Graph	1	x	sonic resonance		23		0.021				52.8			
143	Graph	1	x	sonic resonance		23		0.049				50.4			

Sm_2O_3 { samarium oxide, samaria }

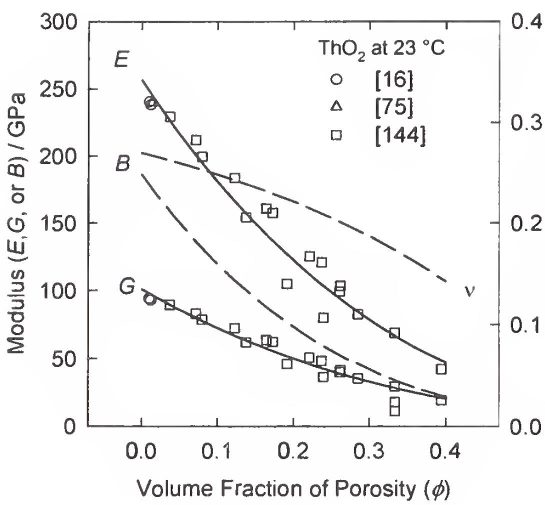
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
143	Graph	1	x	sonic resonance		23		0.055				50.4			
143	Graph	1	x	sonic resonance		23		0.081				46.7			
143	Graph	1	x	sonic resonance		23		0.094				46.4			
143	Graph	1	x	sonic resonance		23		0.108				42.2			
143	Graph	1	x	sonic resonance		23		0.117				41.8			
143	Graph	1	x	sonic resonance		23		0.262				25.4			
143	Graph	1	x	sonic resonance		23		0.278				24.4			
143	Graph	1	x	sonic resonance		23		0.373				15.5			
143	Graph	1	x	sonic resonance		23		0.375				14.1			
143	Graph	1	x	sonic resonance		23		0.377				12.9			
143	Graph	2	x	sonic resonance		102		0.019				52.4			
143	Graph	2	x	sonic resonance		176		0.019				51.5			
143	Graph	2	x	sonic resonance		271		0.019				50.8			
143	Graph	2	x	sonic resonance		367		0.019				49.8			
143	Graph	2	x	sonic resonance		469		0.019				49.1			
143	Graph	2	x	sonic resonance		552		0.019				48.3			
143	Graph	2	x	sonic resonance		638		0.019				47.8			
143	Graph	2	x	sonic resonance		717		0.019				46.9			
143	Graph	2	x	sonic resonance		1002		0.019				43.2			
143	Graph	2	x	sonic resonance		1100		0.019				42.6			
143	Graph	2	x	sonic resonance		1217		0.019				41.3			
143	Graph	1	x	sonic resonance		23		0.017						0.319	
143	Graph	1	x	sonic resonance		23		0.021						0.319	
143	Graph	1	x	sonic resonance		23		0.047						0.325	
143	Graph	1	x	sonic resonance		23		0.056						0.328	
143	Graph	1	x	sonic resonance		23		0.081						0.312	
143	Graph	1	x	sonic resonance		23		0.093						0.332	
143	Graph	1	x	sonic resonance		23		0.108						0.303	
143	Graph	1	x	sonic resonance		23		0.117						0.318	
143	Graph	1	x	sonic resonance		23		0.263						0.260	
143	Graph	1	x	sonic resonance		23		0.278						0.251	
143	Graph	1	x	sonic resonance		23		0.374						0.235	
143	Graph	1	x	sonic resonance		23		0.377						0.244	

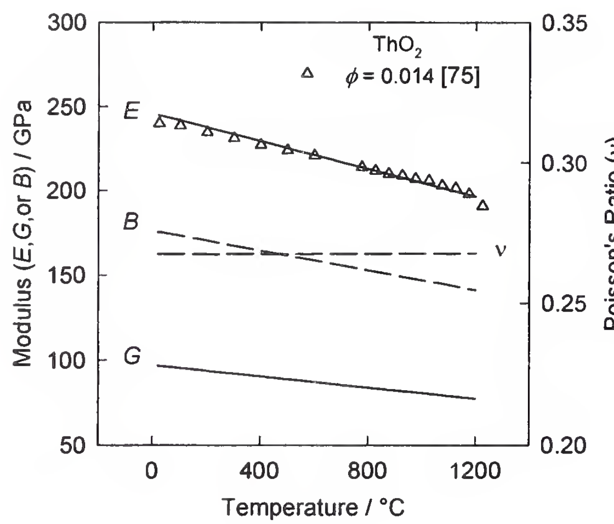
Sm_2O_3 { samarium oxide, samaria }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
143	Graph	1	x	sonic resonance		23		0.373						0.248	
143	Graph	1	x	sonic resonance		23		0.38						0.237	

9.32 ThO_2 { thorium dioxide, thoria }

M_r / (g mol^{-1}) = 264.037	Temperature range / (°C) = 0 to 1200	
ρ_{theo} / (g cm^{-3}) = 10.0	Porosity range = 0 to 0.4	
	E_o / (GPa) = 258	B_o / (GPa) = 187
	a / (10^{-4}°C) = 1.68	b / (10^{-4}°C) = {1.66}
	n = 3.32	m = 4.18





ThO_2 { thorium dioxide, thoria }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
16	Table	6	x	resonance	1	23	9.722	0.01008			240.4	94.2	178.5	0.275	
16	Table	6	x	resonance	2	23	9.702	0.012016			238.4	93.0	181.9	0.282	
75	Table	II	x	sonic resonance		23	9.68	0.014257			240				
75	Graph	3	x	sonic resonance		23	9.68				240.7				
75	Graph	3	x	sonic resonance		100					238.7				
75	Graph	3	x	sonic resonance		200					234.7				
75	Graph	3	x	sonic resonance		300					231.2				
75	Graph	3	x	sonic resonance		400					227.2				
75	Graph	3	x	sonic resonance		500					224.1				
75	Graph	3	x	sonic resonance		600					221.1				
75	Graph	3	x	sonic resonance		775					214.1				
75	Graph	3	x	sonic resonance		825					212.1				
75	Graph	3	x	sonic resonance		875					210.1				
75	Graph	3	x	sonic resonance		925					209.1				
75	Graph	3	x	sonic resonance		975					207.1				
75	Graph	3	x	sonic resonance		1025					206.1				
75	Graph	3	x	sonic resonance		1075					203.1				
75	Graph	3	x	sonic resonance		1125					201.5				
75	Graph	3	x	sonic resonance		1175					198.0				
75	Graph	3	x	sonic resonance		1225					191.0				
144	Table	1	x	sonic resonance		23		0.0373			229.5	89.41		0.284	1
144	Table	1	x	sonic resonance		23		0.0797			199.4	78.51		0.269	1
144	Table	1	x	sonic resonance		23		0.1374			154.3	62.07		0.225	1
144	Table	1	x	sonic resonance		23		0.1915			105.0	46.10		0.112	1
144	Table	1	x	sonic resonance		23		0.2391			79.9	36.58		0.065	1
144	Table	1	x	sonic resonance		23		0.334			18.0	11.45		-0.270	1
144	Table	1	x	sonic resonance		23		0.0715			212.1	83.05		0.276	2
144	Table	1	x	sonic resonance		23		0.1227			183.7	72.40		0.267	2
144	Table	1	x	sonic resonance		23		0.1643			160.8	63.84		0.256	2
144	Table	1	x	sonic resonance		23		0.2205			125.5	50.76		0.229	2

ThO_2 { thorium dioxide, thoria }

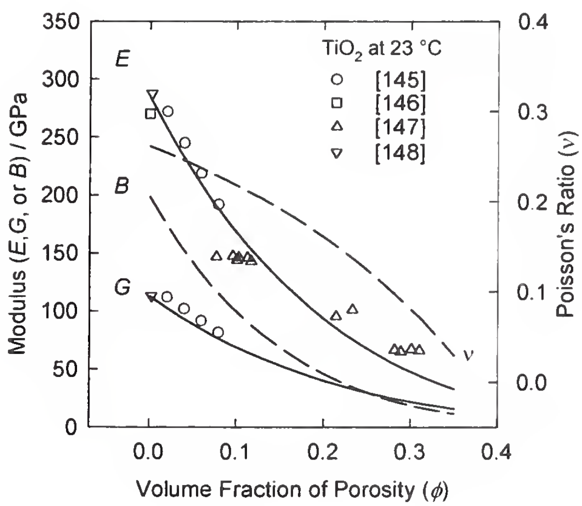
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
144	Table	1	x	sonic resonance		23		0.285			82.5	35.33		0.156	2
144	Table	1	x	sonic resonance		23		0.3336			68.8	29.48		0.155	2
144	Table	1	x	sonic resonance		23		0.3944			42.3	19.34		0.062	2
144	Table	1	x	sonic resonance		23		0.1727			157.4	62.26		0.257	3
144	Table	1	x	sonic resonance		23		0.2366			120.9	48.42		0.239	3
144	Table	1	x	sonic resonance		23		0.2619			103.5	41.74		0.232	3
144	Table	1	x	sonic resonance		23		0.2608			99.3	40.18		0.227	3

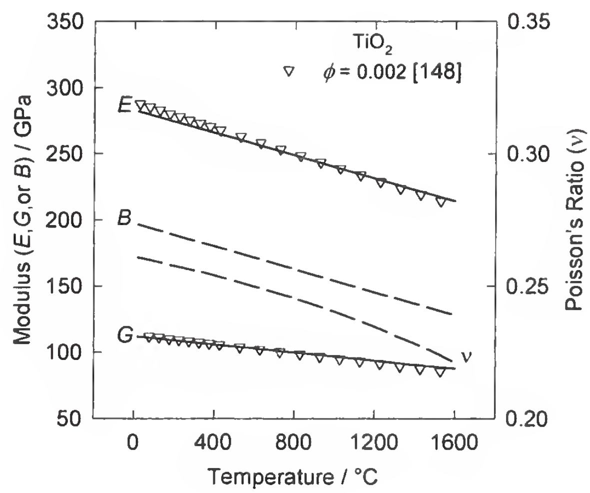
Footnotes:

1: Group I, initial particle size range from 0 μm to 2 μm.
2: Group II, initial particle size range from 2 μm to 4 μm.
3: Group III, initial particle size range from 4 μm to 44 μm.

9.33 TiO_2 { titanium dioxide, titania }

M_r / (g mol^{-1}) = 79.866	Temperature range / (°C) = 0 to 1600	
ρ_{theo} / (g cm^{-3}) = 4.25	Porosity range = 0 to 0.35	
	E_o / (GPa) = 286	B_o / (GPa) = {200}
	a / (10^{-4}°C) = 1.52	b / (10^{-4}°C) = {2.20}
	n = 4.99	m = {6.57}





TiO_2 { titanium dioxide, titania }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
145	Text	458	s	sonic resonance		23	3.864	0.08			192	81.5			1
145	Text	458	s	sonic resonance		23	3.948	0.06			219	91.5			1
145	Text	458	s	sonic resonance		23	4.032	0.04			245	102			1
145	Text	458	s	sonic resonance		23	4.116	0.02			272	112			1
146	Table	2	x	bending (3-pt)		23	4.21				270				
147	Graph	3	x	SAWS	x280	23	2.97	0.301012			146				2
147	Graph	3	x	SAWS	x280	23	3.26	0.232761			146				2
147	Graph	3	x	SAWS	x280	23	3.77	0.112732			143				2
147	Graph	3	x	SAWS	x280	23	3.81	0.103318			101				2
147	Graph	3	x	SAWS	x500	23	2.93	0.310426			67				3
147	Graph	3	x	SAWS	x500	23	3.75	0.117439			66				3
147	Table	2	x	SAWS	RE514	23	3.02	0.289245			65				
147	Table	2	x	SAWS	RE291	23	3.05	0.282184			66.5				
147	Table	2	x	SAWS	RE279	23	3.34	0.213933			95				
147	Table	2	x	SAWS	IP499	23	3.82	0.100965			144				
147	Table	2	x	SAWS	IP271	23	3.84	0.096258			147.5				
147	Table	2	x	SAWS	IP286	23	3.92	0.07743			147				
148	Table	2	x	rec.par.resonance		27	4.24	0.002353	9.24	5.16		113.1	210.3		4
148	Table	2	x	rec.par.resonance		77			9.22	5.14		112.2	208.7		4
148	Table	2	x	rec.par.resonance		127			9.18	5.13		111.3	206.5		4
148	Table	2	x	rec.par.resonance		177			9.14	5.11		110.2	203.7		4
148	Table	2	x	rec.par.resonance		227			9.12	5.09		109.4	202.1		4
148	Table	2	x	rec.par.resonance		277			9.07	5.07		108.4	199.2		4
148	Table	2	x	rec.par.resonance		327			9.04	5.05		107.5	196.6		4
148	Table	2	x	rec.par.resonance		377			9	5.03		106.6	194.3		4
148	Table	2	x	rec.par.resonance		427			8.96	5.01		105.7	191.4		4
148	Table	2	x	rec.par.resonance		527			8.9	4.98		103.9	186.7		4
148	Table	2	x	rec.par.resonance		627			8.83	4.94		102.1	182.1		4
148	Table	2	x	rec.par.resonance		727			8.76	4.91		100.4	177		4

TiO_2 { titanium dioxide, titania }

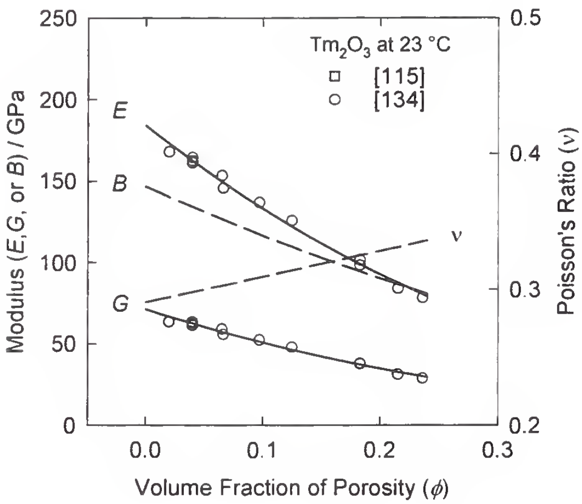
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
148	Table	2	x	rec.par.resonance		827			8.7	4.87		98.6	172.6		4
148	Table	2	x	rec.par.resonance		927			8.63	4.84		96.8	167.7		4
148	Table	2	x	rec.par.resonance		1027			8.58	4.8		95.1	163.7		4
148	Table	2	x	rec.par.resonance		1127			8.51	4.77		93.3	158.4		4
148	Table	2	x	rec.par.resonance		1227			8.44	4.73		91.5	153.8		4
148	Table	2	x	rec.par.resonance		1327			8.38	4.69		89.5	149.5		4
148	Table	2	x	rec.par.resonance		1427			8.33	4.65		87.8	145.4		4
148	Table	2	x	rec.par.resonance		1527			8.26	4.61		85.9	140.8		4

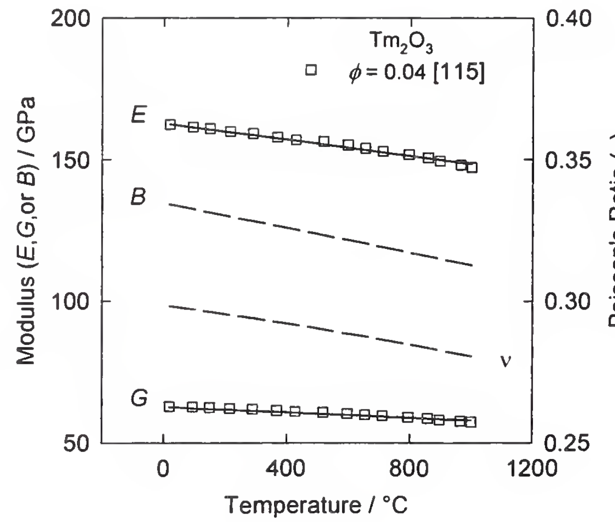
Footnotes:

1: Values from Equations 1,2; converted to SI units.
2: Thin film, 280 nm thick.
3: Thin film, 500 nm thick.
4: Single crystal

9.34 Tm_2O_3 { thulium oxide, thulia }

M_r / (g mol^{-1}) = 385.867 ρ_{theo} / (g cm^{-3}) = 8.889	Temperature range / (°C) = 0 to 1000 Porosity range = 0 to 0.24	
	E_o / (GPa) = 185 a / (10^{-4}°C) = 0.88 n = 3.07	B_o / (GPa) = 147 b / (10^{-4}°C) = 1.63 m = 2.18





Tm_2O_3 { thulium oxide, thulia }

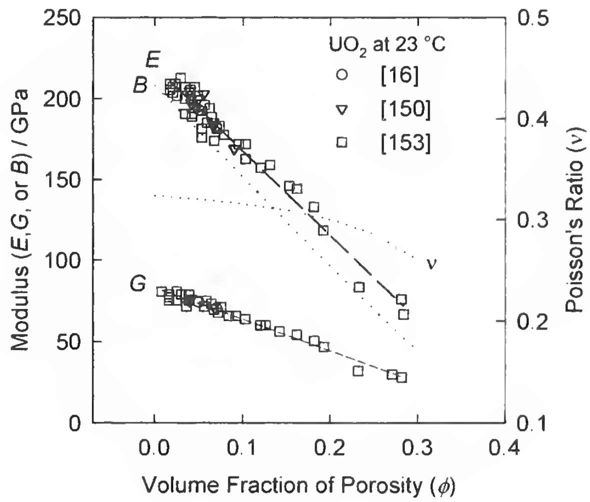
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
115	Graph	1	x	sonic resonance		20	8.534				162.8	62.8			
115	Graph	1	x	sonic resonance		96					161.4	62.4			
115	Graph	1	x	sonic resonance		152					160.9	62.4			
115	Graph	1	x	sonic resonance		217					160.0	62.0			
115	Graph	1	x	sonic resonance		290					159.1	62.0			
115	Graph	1	x	sonic resonance		367					158.2	61.2			
115	Graph	1	x	sonic resonance		428					157.3	60.8			
115	Graph	1	x	sonic resonance		518					155.9	60.4			
115	Graph	1	x	sonic resonance		597					155.0	60.0			
115	Graph	1	x	sonic resonance		654					153.6	59.6			
115	Graph	1	x	sonic resonance		711					152.7	59.2			
115	Graph	1	x	sonic resonance		795					151.4	58.4			
115	Graph	1	x	sonic resonance		857					150.0	58.4			
115	Graph	1	x	sonic resonance		896					149.5	58.0			
115	Graph	1	x	sonic resonance		964					148.2	57.6			
115	Graph	1	x	sonic resonance		1000					147.7	57.2			
115	Table	I	x	sonic resonance		20	8.534	0.040			162.4	62.8	130.1	0.292	
115	Table	I	x	sonic resonance		96					161.5	62.7	127.0	0.288	
115	Table	I	x	sonic resonance		152					161.0	62.5	126.6	0.288	
115	Table	I	x	sonic resonance		217					159.9	62.1	125.7	0.288	
115	Table	I	x	sonic resonance		290					159.2	61.9	124.0	0.286	
115	Table	I	x	sonic resonance		367					157.9	61.4	123.0	0.286	
115	Table	I	x	sonic resonance		428					156.9	61.0	122.8	0.287	
115	Table	I	x	sonic resonance		518					156.4	60.7	123.5	0.289	
115	Table	I	x	sonic resonance		597					155.1	60.3	120.8	0.286	
115	Table	I	x	sonic resonance		654					154.0	59.9	119.9	0.286	
115	Table	I	x	sonic resonance		711					152.9	59.5	118.0	0.284	
115	Table	I	x	sonic resonance		795					151.8	59.0	118.2	0.286	
115	Table	I	x	sonic resonance		857					150.7	58.6	116.8	0.285	
115	Table	I	x	sonic resonance		896					149.5	58.1	116.4	0.286	
115	Table	I	x	sonic resonance		964					148.1	57.6	114.8	0.285	
115	Table	I	x	sonic resonance		1000					147.3	57.3	114.2	0.285	

Tm_2O_3 { thulium oxide, thulia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
134	Graph	1	x	sonic resonance		23		0.02			167.9	63.6			
134	Graph	1	x	sonic resonance		23		0.04			164.5	63.5			
134	Graph	1	x	sonic resonance		23		0.04			162.3	62.4			
134	Graph	1	x	sonic resonance		23		0.04			161.2	61.3			
134	Graph	1	x	sonic resonance		23		0.065			153.5	59.1			
134	Graph	1	x	sonic resonance		23		0.066			145.8	55.8			
134	Graph	1	x	sonic resonance		23		0.097			136.9	52.4			
134	Graph	1	x	sonic resonance		23		0.125			125.8	47.9			
134	Graph	1	x	sonic resonance		23		0.183			101.5	37.9			
134	Graph	1	x	sonic resonance		23		0.183			98.2	37.8			
134	Graph	1	x	sonic resonance		23		0.215			83.9	31.2			
134	Graph	1	x	sonic resonance		23		0.236			78.3	28.9			

9.35 UO_2 {uranium dioxide, urania }

M_r / (g mol^{-1}) = 270.028	Temperature range / (°C) = 23 to 23	
ρ_{theo} / (g cm^{-3}) = 10.96	Porosity range = 0 to 0.28	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a



UO_2 { uranium dioxide }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm3		km/s	km/s	GPa	GPa	GPa		
16	Table	6	x	resonance	1	23	10.37				192.9	74.1	162.0	0.302	
16	Table	6	x	resonance	2	23	10.19				182.3	70.6	145.7	0.291	
149	Table	3	x	resonance		23					217	81.4			
149	Table	3	x	resonance		23					244	93.3			
150	Table	3	x	ult. pulse echo		23		0.039	5.227	2.722	204.7	75.0	183.4	0.314	
150	Table	3	x	ult. pulse echo		23		0.041	5.100	2.698	199.9	76.5	171.7	0.306	
150	Graph	4	x	ult. pulse echo		23		0.04			204.4				
150	Graph	4	x	ult. pulse echo		23		0.041			200.0				
150	Graph	4	x	ult. pulse echo		23		0.049			199.8				
150	Graph	4	x	ult. pulse echo		23		0.055			202.8				
150	Graph	4	x	ult. pulse echo		23		0.066			183.3				
150	Graph	4	x	ult. pulse echo		23		0.09			169.4				
150	Graph	4	x	resonance		23		0.041			197.2				
150	Graph	4	x	resonance		23		0.066			185.7				
150	Graph	4	x	resonance		23		0.09			169.0				
151	Graph	1	x	ultrasonic velocity		23	9.76		4.60						
151	Graph	1	x	ultrasonic velocity		23	9.80		4.64						
151	Graph	1	x	ultrasonic velocity		23	9.82		4.63						
151	Graph	1	x	ultrasonic velocity		23	9.81		4.67						
151	Graph	1	x	ultrasonic velocity		23	9.97		4.74						
151	Graph	1	x	ultrasonic velocity		23	9.96		4.76						
151	Graph	1	x	ultrasonic velocity		23	9.97		4.78						
151	Graph	1	x	ultrasonic velocity		23	10.11		4.86						
151	Graph	1	x	ultrasonic velocity		23	10.12		4.89						
151	Graph	1	x	ultrasonic velocity		23	10.27		4.99						
151	Graph	1	x	ultrasonic velocity		23	10.28		4.98						
151	Graph	1	x	ultrasonic velocity		23	10.30		4.99						
151	Graph	1	x	ultrasonic velocity		23	10.32		5.01						
151	Graph	1	x	ultrasonic velocity		23	10.32		5.01						

UO_2 { uranium dioxide }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm3		km/s	km/s	GPa	GPa	GPa		
151	Graph	1	x	ultrasonic velocity		23	10.42		5.07						
151	Graph	1	x	ultrasonic velocity		23	10.46		5.13						
151	Graph	1	x	ultrasonic velocity		23	10.49		5.15						
152	Text	38	x	sonic resonance		23	10.33				198				
153	Graph	2	x	ultrasonic velocity		23		0.017			209.1				
153	Graph	2	x	ultrasonic velocity		23		0.017			205.4				
153	Graph	2	x	ultrasonic velocity		23		0.020			207.2				
153	Graph	2	x	ultrasonic velocity		23		0.020			203.6				
153	Graph	2	x	ultrasonic velocity		23		0.025			201.7				
153	Graph	2	x	ultrasonic velocity		23		0.023			209.1				
153	Graph	2	x	ultrasonic velocity		23		0.029			212.7				
153	Graph	2	x	ultrasonic velocity		23		0.034			207.2				
153	Graph	2	x	ultrasonic velocity		23		0.034			199.8				
153	Graph	2	x	ultrasonic velocity		23		0.040			205.3				
153	Graph	2	x	ultrasonic velocity		23		0.045			207.1				
153	Graph	2	x	ultrasonic velocity		23		0.048			201.6				
153	Graph	2	x	ultrasonic velocity		23		0.045			194.3				
153	Graph	2	x	ultrasonic velocity		23		0.034			190.7				
153	Graph	2	x	ultrasonic velocity		23		0.042			190.6				
153	Graph	2	x	ultrasonic velocity		23		0.042			188.8				
153	Graph	2	x	ultrasonic velocity		23		0.053			192.4				
153	Graph	2	x	ultrasonic velocity		23		0.056			196.1				
153	Graph	2	x	ultrasonic velocity		23		0.062			194.2				
153	Graph	2	x	ultrasonic velocity		23		0.064			188.7				
153	Graph	2	x	ultrasonic velocity		23		0.059			185.1				
153	Graph	2	x	ultrasonic velocity		23		0.053			181.4				
153	Graph	2	x	ultrasonic velocity		23		0.053			175.9				
153	Graph	2	x	ultrasonic velocity		23		0.070			181.3				
153	Graph	2	x	ultrasonic velocity		23		0.073			183.2				
153	Graph	2	x	ultrasonic velocity		23		0.067			174.0				
153	Graph	2	x	ultrasonic velocity		23		0.078			177.6				

UO_2 { uranium dioxide }

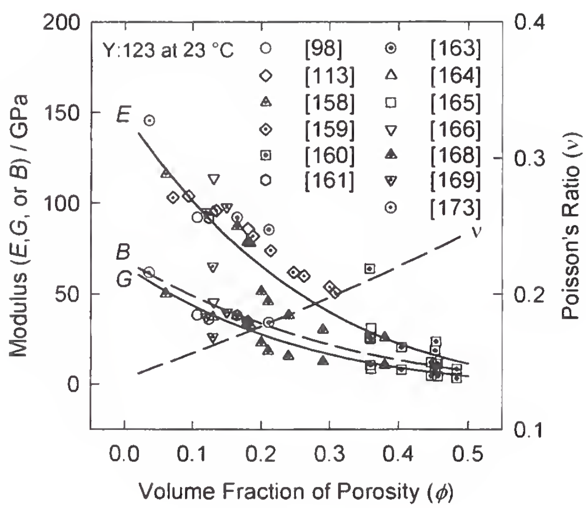
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm3		km/s	km/s	GPa	GPa	GPa		
153	Graph	2	x	ultrasonic velocity		23		0.095			172.0				
153	Graph	2	x	ultrasonic velocity		23		0.103			172.0				
153	Graph	2	x	ultrasonic velocity		23		0.103			162.8				
153	Graph	2	x	ultrasonic velocity		23		0.120			157.2				
153	Graph	2	x	ultrasonic velocity		23		0.131			159.0				
153	Graph	2	x	ultrasonic velocity		23		0.153			146.1				
153	Graph	2	x	ultrasonic velocity		23		0.162			144.2				
153	Graph	2	x	ultrasonic velocity		23		0.181			133.1				
153	Graph	2	x	ultrasonic velocity		23		0.192			118.4				
153	Graph	2	x	ultrasonic velocity		23		0.233			83.3				
153	Graph	2	x	ultrasonic velocity		23		0.281			75.8				
153	Graph	2	x	ultrasonic velocity		23		0.284			66.6				
153	Graph	2	x	ultrasonic velocity		23		0.008				80.7			
153	Graph	2	x	ultrasonic velocity		23		0.016				78.8			
153	Graph	2	x	ultrasonic velocity		23		0.016				77.0			
153	Graph	2	x	ultrasonic velocity		23		0.016				75.2			
153	Graph	2	x	ultrasonic velocity		23		0.025				75.1			
153	Graph	2	x	ultrasonic velocity		23		0.025				80.6			
153	Graph	2	x	ultrasonic velocity		23		0.030				78.8			
153	Graph	2	x	ultrasonic velocity		23		0.039				78.7			
153	Graph	2	x	ultrasonic velocity		23		0.039				75.1			
153	Graph	2	x	ultrasonic velocity		23		0.036				71.4			
153	Graph	2	x	ultrasonic velocity		23		0.056				71.3			
153	Graph	2	x	ultrasonic velocity		23		0.058				75.0			
153	Graph	2	x	ultrasonic velocity		23		0.064				73.1			
153	Graph	2	x	ultrasonic velocity		23		0.067				69.4			
153	Graph	2	x	ultrasonic velocity		23		0.072				67.6			
153	Graph	2	x	ultrasonic velocity		23		0.075				71.2			
153	Graph	2	x	ultrasonic velocity		23		0.084				65.7			
153	Graph	2	x	ultrasonic velocity		23		0.092				65.6			
153	Graph	2	x	ultrasonic velocity		23		0.103				63.7			
153	Graph	2	x	ultrasonic velocity		23		0.120				60.0			
153	Graph	2	x	ultrasonic velocity		23		0.126				60.0			

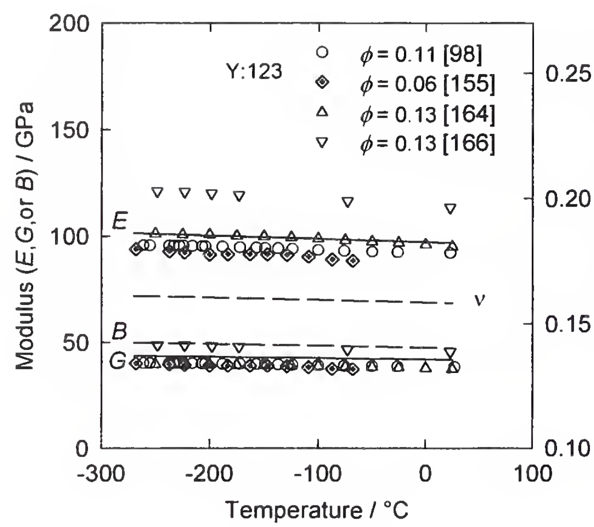
UO_2 { uranium dioxide }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm3		km/s	km/s	GPa	GPa	GPa		
153	Graph	2	x	ultrasonic velocity		23		0.142				56.2			
153	Graph	2	x	ultrasonic velocity		23		0.162				54.3			
153	Graph	2	x	ultrasonic velocity		23		0.182				50.5			
153	Graph	2	x	ultrasonic velocity		23		0.193				46.8			
153	Graph	2	x	ultrasonic velocity		23		0.232				32.0			
153	Graph	2	x	ultrasonic velocity		23		0.271				29.9			
153	Graph	2	x	ultrasonic velocity		23		0.282				28.1			
154	Graph	2	x	microechography		23		0.019	5.354						
154	Graph	2	x	microechography		23		0.0275	5.238						
154	Graph	2	x	microechography		23		0.041	5.143						
154	Graph	2	x	microechography		23		0.0495	5.086						
154	Graph	2	x	microechography		23		0.0718	4.913						

9.36 $YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

M_r / (g mol^{-1}) = 666.194-15.999x ρ_{theo} / (g cm^{-3}) = 6.37 (x = 0.1)	Temperature range / (°C) = -268 to 25 Porosity range = 0 to 0.5	
	E_o / (GPa) = 150 a / (10^{-4}°C) = 1.54 n = 3.70	B_o / (GPa) = 69 b / (10^{-4}°C) = 1.84 m = 3.19





$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
98	Table	2	x	ultrasonic velocity		27	5.69		4.242	2.599	92.2	38.4		0.20	1
98	Graph	2	x	ultrasonic velocity		-261					95.77	40.17	51.67	0.1910	
98	Graph	2	x	ultrasonic velocity		-255					95.70	40.17	51.67	0.1911	
98	Graph	2	x	ultrasonic velocity		-237					95.64	40.15	51.63	0.1911	
98	Graph	2	x	ultrasonic velocity		-233					95.58	40.12	51.60	0.1911	
98	Graph	2	x	ultrasonic velocity		-228					95.53	40.12	51.56	0.1911	
98	Graph	2	x	ultrasonic velocity		-224					95.53	40.12	51.50	0.1909	
98	Graph	2	x	ultrasonic velocity		-216					95.46	40.07	51.44	0.1909	
98	Graph	2	x	ultrasonic velocity		-207					95.34	40.02	51.44	0.1911	
98	Graph	2	x	ultrasonic velocity		-204					95.29	40.02	51.40	0.1911	
98	Graph	2	x	ultrasonic velocity		-188					95.11	39.88	51.40	0.1916	
98	Graph	2	x	ultrasonic velocity		-172					94.87	39.81	51.33	0.1920	
98	Graph	2	x	ultrasonic velocity		-157					94.64	39.68	51.27	0.1923	
98	Graph	2	x	ultrasonic velocity		-149					94.52	39.66	51.17	0.1923	
98	Graph	2	x	ultrasonic velocity		-137					94.35	39.54	51.17	0.1930	
98	Graph	2	x	ultrasonic velocity		-124					94.12	39.41	51.20	0.1937	
98	Graph	2	x	ultrasonic velocity		-100					93.53	39.14	51.16	0.1952	
98	Graph	2	x	ultrasonic velocity		-76					93.12	38.93	51.13	0.1967	
98	Graph	2	x	ultrasonic velocity		-50					92.76	38.73	51.19	0.1980	
98	Graph	2	x	ultrasonic velocity		-26					92.53	38.56	51.35	0.1995	
113	Table	I	x	ultrasonic velocity		23	5.22				86	35			
155	Text		x	mass & dimensions		23	5.985								
155	Table	1	x	ultrasonic velocity		-68			4.009	2.501	88.5	37.4	46.3	0.182	
155	Table	1	x	ultrasonic velocity		-87			4.035	2.504	89.1	37.5	47.4	0.187	
155	Table	1	x	ultrasonic velocity		-109			4.059	2.525	90.4	38.2	47.7	0.184	
155	Table	1	x	ultrasonic velocity		-129			4.064	2.544	91.2	38.7	47.2	0.178	
155	Table	1	x	ultrasonic velocity		-147			4.064	2.550	91.5	38.9	47.0	0.175	
155	Table	1	x	ultrasonic velocity		-163			4.064	2.553	91.6	39.0	46.8	0.174	
155	Table	1	x	ultrasonic velocity		-183			4.060	2.554	91.6	39.0	46.6	0.173	
155	Table	1	x	ultrasonic velocity		-200			4.055	2.553	91.4	39.0	46.4	0.172	

$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
155	Table	1	x	ultrasonic velocity		-223			4.081	2.562	92.3	39.3	47.3	0.175	
155	Table	1	x	ultrasonic velocity		-237			4.100	2.568	92.9	39.5	48.0	0.177	
155	Table	1	x	ultrasonic velocity		-268			4.121	2.583	94.0	40.0	48.4	0.176	
156	Graph	5	x	bending		23		0.011			66				
156	Graph	5	x	bending		23		0.011			97				
156	Graph	5	x	bending		23		0.020			130				
156	Graph	5	x	bending		23		0.010			141				
156	Graph	5	x	bending		23		0.010			162				
156	Graph	5	x	bending		23		0.023			169				
156	Graph	5	x	bending		23		0.050			139				
156	Graph	5	x	bending		23		0.093			103				
156	Graph	5	x	bending		23		0.110			121				
156	Graph	5	x	bending		23		0.110			131				
156	Graph	5	x	bending		23		0.131			143				
156	Graph	5	x	bending		23		0.130			119				
156	Graph	5	x	bending		23		0.180			96				
156	Graph	5	x	bending		23		0.180			101				
156	Graph	5	x	bending		23		0.180			105				
156	Graph	5	x	bending		23		0.180			108				
156	Graph	5	x	bending		23		0.178			117				
156	Graph	5	x	bending		23		0.189			108				
156	Graph	5	x	bending		23		0.191			106				
156	Graph	5	x	bending		23		0.190			98				
156	Graph	5	x	bending		23		0.199			95				
156	Graph	5	x	bending		23		0.207			91				
156	Graph	5	x	bending		23		0.236			79				
156	Graph	5	x	bending		23		0.234			89				
156	Graph	5	x	bending		23		0.236			95				
156	Graph	5	x	bending		23		0.238			99				
156	Graph	5	x	bending		23		0.234			108				
158	Table	1	x	ultrasonic velocity		22	5.199		4.067	2.507	78.0	32.7	42.4	0.194	2

$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
158	Table	1	x	ultrasonic velocity		22	5.985		4.537	2.893	116	50.1	56.4	0.157	2
159	Graph	2b	x	ult. pulse echo		23					51				
159	Graph	2b	x	ult. pulse echo		23					54				
159	Graph	2b	x	ult. pulse echo		23					60				
159	Graph	2b	x	ult. pulse echo		23					62				
159	Graph	2b	x	ult. pulse echo		23					74				
159	Graph	2b	x	ult. pulse echo		23					82				
159	Graph	2b	x	ult. pulse echo		23					96				
159	Graph	2b	x	ult. pulse echo		23					104				
159	Graph	2b	x	ult. pulse echo		23					103				
160	Table	1	x	ult. pulse echo		23	3.215				8.4	3.28	6.43	0.280	
160	Table	1	x	ult. pulse echo		23	3.386				11.3	4.42	8.49	0.279	
160	Table	1	x	ult. pulse echo		23	3.400				23.7	11.20	8.87	0.058	
160	Table	1	x	ult. pulse echo		23	3.408				18.7	7.92	9.74	0.180	
160	Table	1	x	ult. pulse echo		23	3.444				12.2	4.70	10.19	0.298	
160	Table	1	x	ult. pulse echo		23	3.709				20.5	8.05	15.20	0.273	
160	Table	1	x	ult. pulse echo		23	3.985				25.3	10.60	13.70	0.193	
160	Table	1	x	ult. pulse echo		23	3.993				63.9	26.20	38.00	0.219	
160	Graph	1	x	ult. pulse echo		23	3.215		1.86	1.02					
160	Graph	1	x	ult. pulse echo		23	3.386		2.10	1.17					
160	Graph	1	x	ult. pulse echo		23	3.400		2.66	1.83					
160	Graph	1	x	ult. pulse echo		23	3.408		2.46	1.55					
160	Graph	1	x	ult. pulse echo		23	3.444		2.18	1.19					
160	Graph	1	x	ult. pulse echo		23	3.709		2.63	1.51					
160	Graph	1	x	ult. pulse echo		23	3.985		2.67	1.66					
160	Graph	1	x	ult. pulse echo		23	3.993		4.29	2.57					
161	Table	II	x	ultrasonic velocity		23	5.580		4.590	2.540	92.0	36.0	69.0	0.279	
162	Table	III	x	ultrasonic velocity		22	6.070	0.042	4.283	2.717	104.2	44.8	51.6	0.163	
162	Table	III	x	ultrasonic velocity		10			4.290	2.726	104.8	45.1	51.6	0.161	

$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
162	Table	III	x	ultrasonic velocity		6			4.295	2.733	105.2	45.3	51.5	0.160	
162	Table	III	x	ultrasonic velocity		0			4.300	2.736	105.4	45.4	51.7	0.160	
162	Table	III	x	ultrasonic velocity		-5			4.309	2.736	105.6	45.4	52.1	0.162	
162	Table	III	x	ultrasonic velocity		-10			4.318	2.744	106.2	45.7	52.2	0.161	
162	Table	III	x	ultrasonic velocity		-15			4.322	2.751	106.5	45.9	52.2	0.159	
162	Table	III	x	ultrasonic velocity		-20			4.333	2.755	107.0	46.9	52.5	0.160	
163	Table	1	x	ultrasonic velocity		23	5.150	0.211	4.076	2.550	85.5	34.2	57.0		3,4
163	Table	1	x	ultrasonic velocity		23	5.450	0.165	4.122	2.650	92.2	38.13	50.9		5
163	Graph	3	x	ultrasonic velocity	Y1	-198			2.63						4
163	Graph	3	x	ultrasonic velocity	Y1	-192			2.62		33.48788				4
163	Graph	3	x	ultrasonic velocity	Y1	-189			2.52		38.27263				4
163	Graph	3	x	ultrasonic velocity	Y1	-188			2.47						4
163	Graph	3	x	ultrasonic velocity	Y1	-187			2.39						4
163	Graph	3	x	ultrasonic velocity	Y1	-187			2.30						4
163	Graph	3	x	ultrasonic velocity	Y1	-186			2.14						4
163	Graph	3	x	ultrasonic velocity	Y1	-181			2.02						4
163	Graph	3	x	ultrasonic velocity	Y1	-176			2.03						4
163	Graph	3	x	ultrasonic velocity	Y1	-173			2.08						4
163	Graph	3	x	ultrasonic velocity	Y1	-171			2.12						4
163	Graph	3	x	ultrasonic velocity	Y1	-168			2.16						4
163	Graph	3	x	ultrasonic velocity	Y1	-164			2.20						4
163	Graph	3	x	ultrasonic velocity	Y1	-161			2.28						4
163	Graph	3	x	ultrasonic velocity	Y1	-157			2.33						4
163	Graph	3	x	ultrasonic velocity	Y1	-150			2.43						4
163	Graph	3	x	ultrasonic velocity	Y1	-145			2.51						4
163	Graph	3	x	ultrasonic velocity	Y1	-140			2.56						4
163	Graph	3	x	ultrasonic velocity	Y1	-133			2.60						4
163	Graph	3	x	ultrasonic velocity	Y1	-127			2.60						4
163	Graph	3	x	ultrasonic velocity	Y1	-122			2.61						4
163	Graph	3	x	ultrasonic velocity	Y1	-117			2.61						4
163	Graph	3	x	ultrasonic velocity	Y1	-113			2.63						4
163	Graph	3	x	ultrasonic velocity	Y1	-107			2.65						4

$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
163	Graph	3	x	ultrasonic velocity	Y1	-100			2.70						4
163	Graph	3	x	ultrasonic velocity	Y1	-94			2.76						4
163	Graph	3	x	ultrasonic velocity	Y1	-89			2.84						4
163	Graph	3	x	ultrasonic velocity	Y1	-84			2.94						4
163	Graph	3	x	ultrasonic velocity	Y1	-81			3.00						4
163	Graph	3	x	ultrasonic velocity	Y1	-79			3.07						4
163	Graph	3	x	ultrasonic velocity	Y1	-76			3.13						4
163	Graph	3	x	ultrasonic velocity	Y1	-73			3.19						4
163	Graph	3	x	ultrasonic velocity	Y1	-70			3.34						4
163	Graph	3	x	ultrasonic velocity	Y1	-67			3.45						4
163	Graph	3	x	ultrasonic velocity	Y1	-67			3.52						4
163	Graph	3	x	ultrasonic velocity	Y1	-61			3.57						4
163	Graph	3	x	ultrasonic velocity	Y1	-56			3.56						4
163	Graph	3	x	ultrasonic velocity	Y1	-52			3.54						4
163	Graph	3	x	ultrasonic velocity	Y1	-50			3.47						4
163	Graph	3	x	ultrasonic velocity	Y1	-49			3.38						4
163	Graph	3	x	ultrasonic velocity	Y1	-47			3.24						4
163	Graph	3	x	ultrasonic velocity	Y1	-46			3.11						4
163	Graph	3	x	ultrasonic velocity	Y1	-46			2.96						4
163	Graph	3	x	ultrasonic velocity	Y1	-43			2.88						4
163	Graph	3	x	ultrasonic velocity	Y1	-41			2.78						4
163	Graph	3	x	ultrasonic velocity	Y1	-39			2.69						4
163	Graph	3	x	ultrasonic velocity	Y1	-32			2.66						4
163	Graph	3	x	ultrasonic velocity	Y1	-26			2.64						4
163	Graph	3	x	ultrasonic velocity	Y1	-14			2.63						4
163	Graph	3	x	ultrasonic velocity	Y1	-8			2.63						4
163	Graph	3	x	ultrasonic velocity	Y1	0			2.64						4
163	Graph	3	x	ultrasonic velocity	Y1	4			2.64						4
163	Graph	3	x	ultrasonic velocity	Y1	12			2.64						4
163	Graph	3	x	ultrasonic velocity	Y1	16			2.64						4
163	Graph	3	x	ultrasonic velocity	Y1	22			2.63						4
163	Graph	3	x	ultrasonic velocity	Y1	27	5.15	0.211	2.64						4
163	Graph	4	x	ultrasonic velocity	Y2	-196			2.08						5

$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
163	Graph	4	x	ultrasonic velocity	Y2	-187			2.11						5
163	Graph	4	x	ultrasonic velocity	Y2	-181			2.13						5
163	Graph	4	x	ultrasonic velocity	Y2	-172			2.15						5
163	Graph	4	x	ultrasonic velocity	Y2	-164			2.19						5
163	Graph	4	x	ultrasonic velocity	Y2	-154			2.25						5
163	Graph	4	x	ultrasonic velocity	Y2	-147			2.21						5
163	Graph	4	x	ultrasonic velocity	Y2	-140			2.24						5
163	Graph	4	x	ultrasonic velocity	Y2	-133			2.34						5
163	Graph	4	x	ultrasonic velocity	Y2	-122			2.36						5
163	Graph	4	x	ultrasonic velocity	Y2	-117			2.38						5
163	Graph	4	x	ultrasonic velocity	Y2	-112			2.47						5
163	Graph	4	x	ultrasonic velocity	Y2	-105			2.65						5
163	Graph	4	x	ultrasonic velocity	Y2	-104			2.84						5
163	Graph	4	x	ultrasonic velocity	Y2	-99			3.00						5
163	Graph	4	x	ultrasonic velocity	Y2	-99			3.25						5
163	Graph	4	x	ultrasonic velocity	Y2	-97			3.54						5
163	Graph	4	x	ultrasonic velocity	Y2	-92			3.91						5
163	Graph	4	x	ultrasonic velocity	Y2	-89			4.11						5
163	Graph	4	x	ultrasonic velocity	Y2	-86			4.28						5
163	Graph	4	x	ultrasonic velocity	Y2	-79			4.52						5
163	Graph	4	x	ultrasonic velocity	Y2	-73			4.65						5
163	Graph	4	x	ultrasonic velocity	Y2	-67			4.75						5
163	Graph	4	x	ultrasonic velocity	Y2	-60			4.81						5
163	Graph	4	x	ultrasonic velocity	Y2	-53			4.82						5
163	Graph	4	x	ultrasonic velocity	Y2	-44			4.82						5
163	Graph	4	x	ultrasonic velocity	Y2	-39			4.70						5
163	Graph	4	x	ultrasonic velocity	Y2	-35			4.59						5
163	Graph	4	x	ultrasonic velocity	Y2	-31			4.47						5
163	Graph	4	x	ultrasonic velocity	Y2	-30			4.33						5
163	Graph	4	x	ultrasonic velocity	Y2	-28			4.08						5
163	Graph	4	x	ultrasonic velocity	Y2	-25			3.71						5
163	Graph	4	x	ultrasonic velocity	Y2	-20			3.55						5
163	Graph	4	x	ultrasonic velocity	Y2	-19			3.30						5

$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
163	Graph	4	x	ultrasonic velocity	Y2	-14			3.14						5
163	Graph	4	x	ultrasonic velocity	Y2	-7			3.12						5
163	Graph	4	x	ultrasonic velocity	Y2	-1			3.14						5
163	Graph	4	x	ultrasonic velocity	Y2	5			3.08						5
163	Graph	4	x	ultrasonic velocity	Y2	12			3.08						5
163	Graph	4	x	ultrasonic velocity	Y2	21			3.07						5
163	Graph	4	x	ultrasonic velocity	Y2	27	5.45	0.165	3.11						5
164	Table	1	x	ultrasonic velocity		22	5.560		4.657	2.590	95.2	37.3	70.8	0.276	6
164	Graph	1a	x	ultrasonic velocity		-253	5.560		4.8						
164	Graph	1a	x	ultrasonic velocity		-222	5.560		4.794						
164	Graph	1a	x	ultrasonic velocity		-196	5.560		4.783						
164	Graph	1a	x	ultrasonic velocity		-164	5.560		4.773						
164	Graph	1a	x	ultrasonic velocity		-136	5.560		4.757						
164	Graph	1a	x	ultrasonic velocity		-108	5.560		4.741						
164	Graph	1a	x	ultrasonic velocity		-84	5.560		4.727						
164	Graph	1a	x	ultrasonic velocity		-56	5.560		4.71						
164	Graph	1a	x	ultrasonic velocity		-36	5.560		4.694						
164	Graph	1a	x	ultrasonic velocity		-12	5.560		4.68						
164	Graph	1a	x	ultrasonic velocity		7	5.560		4.666						
164	Graph	1a	x	ultrasonic velocity		23	5.560		4.658						
164	Graph	1b	x	ultrasonic velocity		-253	5.560			2.67					
164	Graph	1b	x	ultrasonic velocity		-222	5.560			2.667					
164	Graph	1b	x	ultrasonic velocity		-192	5.560			2.664					
164	Graph	1b	x	ultrasonic velocity		-170	5.560			2.658					
164	Graph	1b	x	ultrasonic velocity		-143	5.560			2.652					
164	Graph	1b	x	ultrasonic velocity		-119	5.560			2.645					
164	Graph	1b	x	ultrasonic velocity		-91	5.560			2.637					
164	Graph	1b	x	ultrasonic velocity		-62	5.560			2.629					
164	Graph	1b	x	ultrasonic velocity		-36	5.560			2.618					
164	Graph	1b	x	ultrasonic velocity		-15	5.560			2.61					
164	Graph	1b	x	ultrasonic velocity		1	5.560			2.602					
164	Graph	1b	x	ultrasonic velocity		21	5.560			2.592					

$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
165	Table	3	x	ultrasonic velocity		23	4.100		2.740	1.450	31.15	8.62		0.30	7
166	Table	1	x	ultrasonic velocity		22		0.131			113.7	45.6	75.1	0.248	8
166	Graph	3	x	ultrasonic velocity		-73		0.131			116.5	46.7	76.7	0.247	
166	Graph	3	x	ultrasonic velocity		-173		0.131			119.5	48	78.2	0.246	
166	Graph	3	x	ultrasonic velocity		-198		0.131			120.2	48.3	78.4	0.245	
166	Graph	3	x	ultrasonic velocity		-223		0.131			120.9	48.6	78.7	0.244	
166	Graph	3	x	ultrasonic velocity		-248		0.131			121.2	48.7	78.9	0.244	
167	Table	3	x	flexural resonance		23	4.7	0.26			48.51				
168	Table	1	x	ultrasonic velocity		23	5.344	0.165	4.153	2.671	87.3	38.1			
168	Table	1	x	ultrasonic velocity		23	5.248	0.180	4.036	2.552	78.7	34.2			
168	Table	1	x	ultrasonic velocity		23	5.120	0.200	3.247	2.124	51.5	23.1			
168	Table	1	x	ultrasonic velocity		23	5.056	0.210	3.268	1.912	45.8	18.5			
168	Table	1	x	ultrasonic velocity		23	4.864	0.240	3.041	1.779	38.2	15.4			
168	Table	1	x	ultrasonic velocity		23	4.544	0.290	2.735	1.658	30.2	12.5			
168	Table	1	x	ultrasonic velocity		23	3.968	0.380	2.749	1.634	25.9	10.6			
169	Table	I	x	ultrasonic velocity	1	22	5.470	0.13	3.740	2.200	65.3	26.4	41.4	0.237	
169	Table	I	x	ultrasonic velocity	2	22	5.365	0.15	4.570	2.730	97.9	40.1	58.5	0.221	
169	Table	I	x	ultrasonic velocity	3	22	5.560	0.12	4.657	2.590	95.2	37.3	70.8	0.276	
170	Table	2	x	ult. pulse echo		23	4.98	0.221	4.550	2.630		35	57		
170	Table	2	x	ult. pulse echo		23	4.74	0.258	4.360	2.540		31	50		
170	Table	2	x	ult. pulse echo		23	4.70	0.265	4.220	2.440		28	46		
170	Table	2	x	ult. pulse echo		23	4.24	0.337	3.880	2.300		22	34		
170	Table	2	x	ult. pulse echo		23	4.01	0.373	3.320	2.020		16	22		
171	Table	1	x	bending		23	5.82	0.088			128				
171	Table	1	x	bending		23	5.95	0.067			130				
171	Table	1	x	bending		23	6.01	0.058			100				

$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
172	Table	1	x	bending (3-pt)		23		0.05			97.2				
172	Table	1	x	bending (3-pt)		23		0.06			81.1				
172	Table	1	x	bending (3-pt)		23		0.07			62.6				
172	Table	1	x	bending (3-pt)		23		0.15			51.4				
172	Table	1	x	bending (3-pt)		23		0.16			74.4				
172	Table	1	x	bending (3-pt)		23		0.25			32				
172	Table	1	x	bending (3-pt)		23		0.29			22				
172	Table	1	x	bending (3-pt)		23		0.31			19				
173	Table	1	x	ultrasonic velocity		23	5.963	0.036	5.139	3.222	145.5	61.9			
173	Graph	1	x	ultrasonic velocity		-193			5.78						
173	Graph	1	x	ultrasonic velocity		-188			5.78						
173	Graph	1	x	ultrasonic velocity		-183			5.78						
173	Graph	1	x	ultrasonic velocity		-178			5.78						
173	Graph	1	x	ultrasonic velocity		-173			5.77						
173	Graph	1	x	ultrasonic velocity		-163			5.74						
173	Graph	1	x	ultrasonic velocity		-153			5.7						
173	Graph	1	x	ultrasonic velocity		-138			5.68						
173	Graph	1	x	ultrasonic velocity		-128			5.67						
173	Graph	1	x	ultrasonic velocity		-118			5.62						
173	Graph	1	x	ultrasonic velocity		-108			5.59						
173	Graph	1	x	ultrasonic velocity		-98			5.58						
173	Graph	1	x	ultrasonic velocity		-88			5.57						
173	Graph	1	x	ultrasonic velocity		-83			5.54						
173	Graph	1	x	ultrasonic velocity		-78			5.52						
173	Graph	1	x	ultrasonic velocity		-68			5.49						
173	Graph	1	x	ultrasonic velocity		-58			5.45						
173	Graph	1	x	ultrasonic velocity		-48			5.4						
173	Graph	1	x	ultrasonic velocity		-38			5.37						
173	Graph	1	x	ultrasonic velocity		-33			5.34						
173	Graph	1	x	ultrasonic velocity		-23			5.29						
173	Graph	1	x	ultrasonic velocity		-13			5.28						

$YBa_2Cu_3O_{7-x}$ { yttrium barium copper oxide, Y:123, YBCO }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
173	Graph	1	x	ultrasonic velocity		-8			5.23						
173	Graph	1	x	ultrasonic velocity		2			5.2						
173	Graph	1	x	ultrasonic velocity		17			5.16						
173	Graph	1	x	ultrasonic velocity		27	5.963	0.036	5.14						

Footnotes:

1: Critical temperature = 90 K.

2: Y:123 with $O_{6.8}$

3: Critical temperature = 83 K.

4: The tabulated value of V_L at room temperature differs from value reported in Fig. 3.

5: The tabulated value of V_L at room temperature differs from value reported in Fig. 4.

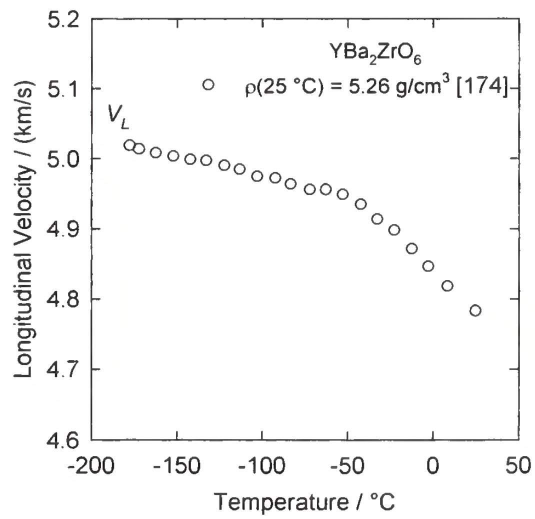
6: Y:123 with $O_{6.94}$

7: Authors reported ρ_{xtal} = 6.632 g/cm^3, but their lattice parameters yield 6.37 g/cm^3 for Y:123 with $O_{6.957}$.

8: Y:123 with $O_{6.85}$

9.37 YBa_2ZrO_6 { yttrium barium zirconate }

M_r / (g mol^{-1}) = 550.780	Temperature range / (°C) = -178 to 25	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a

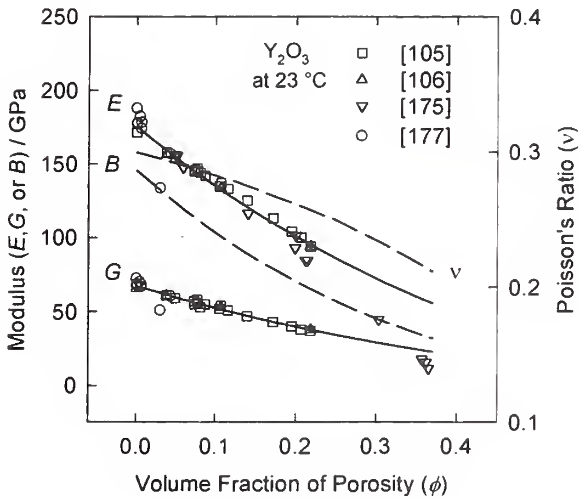


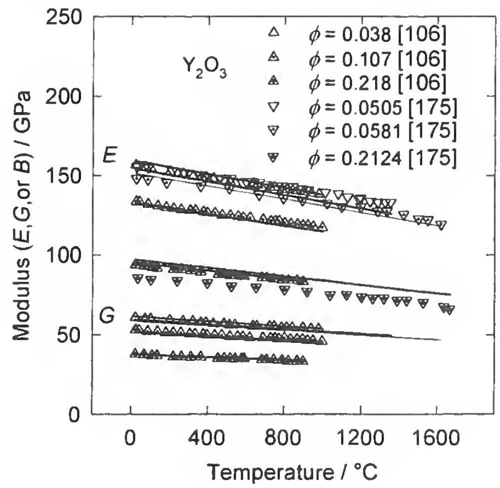
YBa_2ZrO_6 { yttrium barium zirconate }

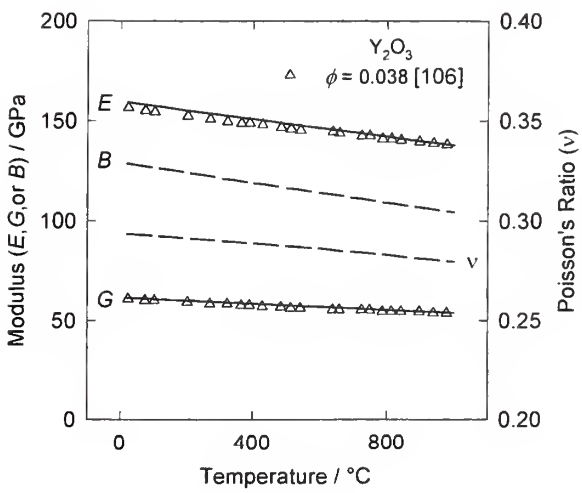
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
174	Graph	4	x	ultrasonic velocity		-177.7			5.019						
174	Graph	4	x	ultrasonic velocity		-172.3			5.014						
174	Graph	4	x	ultrasonic velocity		-162.3			5.009						
174	Graph	4	x	ultrasonic velocity		-152.3			5.004						
174	Graph	4	x	ultrasonic velocity		-142.3			4.999						
174	Graph	4	x	ultrasonic velocity		-133.0			4.998						
174	Graph	4	x	ultrasonic velocity		-122.2			4.991						
174	Graph	4	x	ultrasonic velocity		-113.0			4.985						
174	Graph	4	x	ultrasonic velocity		-103.1			4.975						
174	Graph	4	x	ultrasonic velocity		-92.2			4.973						
174	Graph	4	x	ultrasonic velocity		-83.1			4.964						
174	Graph	4	x	ultrasonic velocity		-72.3			4.956						
174	Graph	4	x	ultrasonic velocity		-63.0			4.956						
174	Graph	4	x	ultrasonic velocity		-53.0			4.949						
174	Graph	4	x	ultrasonic velocity		-42.4			4.935						
174	Graph	4	x	ultrasonic velocity		-32.7			4.914						
174	Graph	4	x	ultrasonic velocity		-22.9			4.898						
174	Graph	4	x	ultrasonic velocity		-12.5			4.872						
174	Graph	4	x	ultrasonic velocity		-2.8			4.847						
174	Graph	4	x	ultrasonic velocity		8.3			4.819						
174	Graph	4	x	ultrasonic velocity		24.8	5.260		4.783						

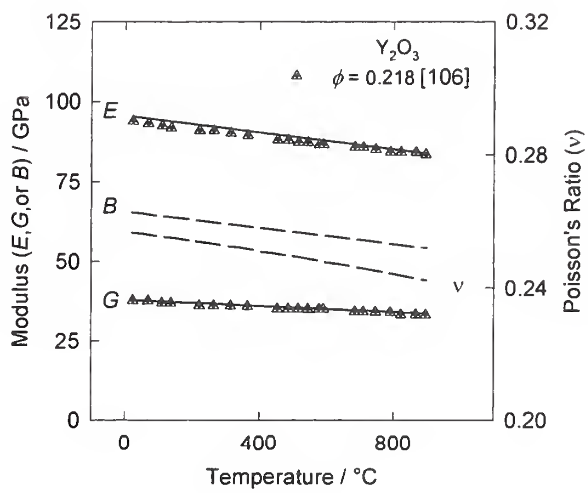
9.38 Y_2O_3 { yttrium oxide, yttria }

M_r / (g mol^{-1}) = 225.810	Temperature range / (°C) = 0 to 1600	
ρ_{theo} / (g cm^{-3}) = 5.03	Porosity range = 0 to 0.37	
	E_o / (GPa) = 176	B_o / (GPa) = 147
	a / (10^{-4} °C) = 1.37	b / (10^{-4} °C) = 1.93
	n = 2.47	m = 3.27









Y_2O_3 { yttrium oxide, yttria }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
105	Table	III	c	extrapolation		23	5.030	0			171.5	66.5	135.7	0.298	
105	Graph	1	x	sonic resonance		23		0.038			158	61			
105	Graph	1	x	sonic resonance		23		0.049			154	59			
105	Graph	1	x	sonic resonance		23		0.073			145	57			
105	Graph	1	x	sonic resonance		23		0.074			146	55			
105	Graph	1	x	sonic resonance		23		0.077			147	58			
105	Graph	1	x	sonic resonance		23		0.078			145	56			
105	Graph	1	x	sonic resonance		23		0.081			144	53			
105	Graph	1	x	sonic resonance		23		0.087			142	55			
105	Graph	1	x	sonic resonance		23		0.105			135	52			
105	Graph	1	x	sonic resonance		23		0.107			137	54			
105	Graph	1	x	sonic resonance		23		0.116			133	51			
105	Graph	1	x	sonic resonance		23		0.14			125	47			
105	Graph	1	x	sonic resonance		23		0.172			113	43			
105	Graph	1	x	sonic resonance		23		0.195			104	40			
105	Graph	1	x	sonic resonance		23		0.206			100	38			
105	Graph	1	x	sonic resonance		23		0.218			94	37			
106	Graph	1	x	dynamic resonance		23		0.218			93.9	37.8			
106	Graph	1	x	dynamic resonance		68		0.218			93.2	37.7			
106	Graph	1	x	dynamic resonance		110		0.218			92.5	37.0			
106	Graph	1	x	dynamic resonance		137		0.218			91.8	37.0			
106	Graph	1	x	dynamic resonance		221		0.218			91.0	36.2			
106	Graph	1	x	dynamic resonance		263		0.218			91.0	36.2			
106	Graph	1	x	dynamic resonance		313		0.218			90.2	36.1			
106	Graph	1	x	dynamic resonance		364		0.218			89.5	36.0			
106	Graph	1	x	dynamic resonance		454		0.218			88.1	35.2			
106	Graph	1	x	dynamic resonance		486		0.218			88.0	35.2			
106	Graph	1	x	dynamic resonance		516		0.218			87.3	35.2			
106	Graph	1	x	dynamic resonance		543		0.218			87.3	35.1			
106	Graph	1	x	dynamic resonance		577		0.218			86.6	35.1			
106	Graph	1	x	dynamic resonance		590		0.218			86.6	35.1			

Y_2O_3 { yttrium oxide, yttria }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
106	Graph	1	x	dynamic resonance		684		0.218			85.8	34.3			
106	Graph	1	x	dynamic resonance		709		0.218			85.8	34.3			
106	Graph	1	x	dynamic resonance		746		0.218			85.1	34.2			
106	Graph	1	x	dynamic resonance		790		0.218			84.3	34.1			
106	Graph	1	x	dynamic resonance		822		0.218			84.3	33.4			
106	Graph	1	x	dynamic resonance		867		0.218			84.2	33.4			
106	Graph	1	x	dynamic resonance		897		0.218			83.5	33.3			
106	Graph	1	x	dynamic resonance		25		0.107			133.6	53.0			
106	Graph	1	x	dynamic resonance		43		0.107			133.5	53.0			
106	Graph	1	x	dynamic resonance		87		0.107			132.1	52.2			
106	Graph	1	x	dynamic resonance		139		0.107			130.8	52.2			
106	Graph	1	x	dynamic resonance		183		0.107			130.0	51.5			
106	Graph	1	x	dynamic resonance		221		0.107			129.3	51.4			
106	Graph	1	x	dynamic resonance		260		0.107			128.6	51.4			
106	Graph	1	x	dynamic resonance		307		0.107			127.9	50.6			
106	Graph	1	x	dynamic resonance		334		0.107			127.9	50.6			
106	Graph	1	x	dynamic resonance		376		0.107			127.1	50.5			
106	Graph	1	x	dynamic resonance		396		0.107			126.5	49.9			
106	Graph	1	x	dynamic resonance		436		0.107			126.4	49.8			
106	Graph	1	x	dynamic resonance		473		0.107			125.0	49.8			
106	Graph	1	x	dynamic resonance		515		0.107			125.0	49.0			
106	Graph	1	x	dynamic resonance		557		0.107			124.3	49.0			
106	Graph	1	x	dynamic resonance		584		0.107			123.6	48.9			
106	Graph	1	x	dynamic resonance		619		0.107			123.5	48.2			
106	Graph	1	x	dynamic resonance		688		0.107			122.1	48.2			
106	Graph	1	x	dynamic resonance		728		0.107			121.4	48.1			
106	Graph	1	x	dynamic resonance		752		0.107			121.4	48.1			
106	Graph	1	x	dynamic resonance		772		0.107			121.3	47.4			
106	Graph	1	x	dynamic resonance		802		0.107			120.0	48.0			
106	Graph	1	x	dynamic resonance		834		0.107			119.3	47.3			
106	Graph	1	x	dynamic resonance		868		0.107			119.2	47.2			
106	Graph	1	x	dynamic resonance		896		0.107			118.5	47.2			
106	Graph	1	x	dynamic resonance		921		0.107			118.5	46.5			

Y_2O_3 { yttrium oxide, yttria }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
106	Graph	1	x	dynamic resonance		950		0.107			117.8	46.5			
106	Graph	1	x	dynamic resonance		997		0.107			117.1	45.8			
106	Graph	1	x	dynamic resonance		22		0.038			156.7	60.9			
106	Graph	1	x	dynamic resonance		73		0.038			155.3	60.2			
106	Graph	1	x	dynamic resonance		101		0.038			154.6	60.1			
106	Graph	1	x	dynamic resonance		202		0.038			152.5	59.4			
106	Graph	1	x	dynamic resonance		271		0.038			151.1	58.6			
106	Graph	1	x	dynamic resonance		323		0.038			149.7	58.5			
106	Graph	1	x	dynamic resonance		365		0.038			149.0	57.8			
106	Graph	1	x	dynamic resonance		390		0.038			148.9	57.8			
106	Graph	1	x	dynamic resonance		429		0.038			148.2	57.1			
106	Graph	1	x	dynamic resonance		484		0.038			146.8	57.0			
106	Graph	1	x	dynamic resonance		513		0.038			146.1	56.3			
106	Graph	1	x	dynamic resonance		541		0.038			145.4	56.3			
106	Graph	1	x	dynamic resonance		637		0.038			144.6	55.5			
106	Graph	1	x	dynamic resonance		657		0.038			143.9	55.5			
106	Graph	1	x	dynamic resonance		724		0.038			142.5	55.4			
106	Graph	1	x	dynamic resonance		748		0.038			142.5	55.3			
106	Graph	1	x	dynamic resonance		786		0.038			141.1	54.6			
106	Graph	1	x	dynamic resonance		813		0.038			141.1	54.6			
106	Graph	1	x	dynamic resonance		842		0.038			140.4	54.6			
106	Graph	1	x	dynamic resonance		897		0.038			139.7	54.5			
106	Graph	1	x	dynamic resonance		939		0.038			138.9	53.8			
106	Graph	1	x	dynamic resonance		979		0.038			138.2	53.7			
175	Graph	1	x	sonic resonance		23		0.049			156.5				
175	Graph	1	x	sonic resonance		23		0.051			155.8				
175	Graph	1	x	sonic resonance		23		0.059			147.6				
175	Graph	1	x	sonic resonance		23		0.141			116.5				
175	Graph	1	x	sonic resonance		23		0.200			101.4				
175	Graph	1	x	sonic resonance		23		0.199			93.1				
175	Graph	1	x	sonic resonance		23		0.212			84.8				
175	Graph	1	x	sonic resonance		23		0.214			84.8				

Y_2O_3 { yttrium oxide, yttria }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
175	Graph	1	x	sonic resonance		23		0.303			44.8				
175	Graph	1	x	sonic resonance		23		0.357			17.9				
175	Graph	1	x	sonic resonance		23		0.362			15.9				
175	Graph	1	x	sonic resonance		23		0.365			11.7				
175	Graph	5	x	sonic resonance		27		0.0505			155.8				
175	Graph	5	x	sonic resonance		86		0.0505			155.1				
175	Graph	5	x	sonic resonance		214		0.0505			153.1				
175	Graph	5	x	sonic resonance		273		0.0505			151.7				
175	Graph	5	x	sonic resonance		352		0.0505			150.3				
175	Graph	5	x	sonic resonance		381		0.0505			148.9				
175	Graph	5	x	sonic resonance		460		0.0505			148.2				
175	Graph	5	x	sonic resonance		519		0.0505			148.2				
175	Graph	5	x	sonic resonance		598		0.0505			146.2				
175	Graph	5	x	sonic resonance		627		0.0505			146.2				
175	Graph	5	x	sonic resonance		667		0.0505			145.5				
175	Graph	5	x	sonic resonance		706		0.0505			144.1				
175	Graph	5	x	sonic resonance		785		0.0505			143.4				
175	Graph	5	x	sonic resonance		844		0.0505			142.7				
175	Graph	5	x	sonic resonance		893		0.0505			141.3				
175	Graph	5	x	sonic resonance		922		0.0505			140.7				
175	Graph	5	x	sonic resonance		1011		0.0505			139.3				
175	Graph	5	x	sonic resonance		1080		0.0505			138.6				
175	Graph	5	x	sonic resonance		1129		0.0505			136.5				
175	Graph	5	x	sonic resonance		1188		0.0505			135.1				
175	Graph	5	x	sonic resonance		1198		0.0505			135.8				
175	Graph	5	x	sonic resonance		1247		0.0505			133.8				
175	Graph	5	x	sonic resonance		1286		0.0505			133.1				
175	Graph	5	x	sonic resonance		1326		0.0505			133.1				
175	Graph	5	x	sonic resonance		1355		0.0505			133.1				
175	Graph	5	x	sonic resonance		26		0.0581			148.2				
175	Graph	5	x	sonic resonance		85		0.0581			147.6				
175	Graph	5	x	sonic resonance		184		0.0581			145.5				
175	Graph	5	x	sonic resonance		361		0.0581			143.4				

Y_2O_3 { yttrium oxide, yttria }

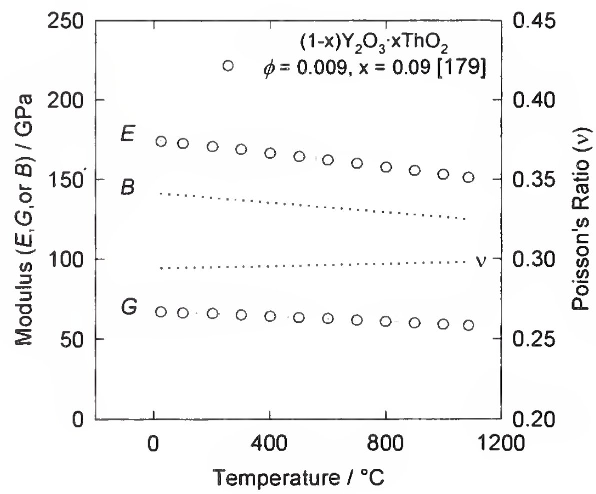
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
175	Graph	5	x	sonic resonance		509		0.0581			142				
175	Graph	5	x	sonic resonance		666		0.0581			137.9				
175	Graph	5	x	sonic resonance		794		0.0581			135.8				
175	Graph	5	x	sonic resonance		892		0.0581			134.5				
175	Graph	5	x	sonic resonance		1020		0.0581			132.4				
175	Graph	5	x	sonic resonance		1099		0.0581			130.3				
175	Graph	5	x	sonic resonance		1197		0.0581			130.3				
175	Graph	5	x	sonic resonance		1286		0.0581			127.6				
175	Graph	5	x	sonic resonance		1335		0.0581			127.6				
175	Graph	5	x	sonic resonance		1424		0.0581			125.5				
175	Graph	5	x	sonic resonance		1502		0.0581			122.7				
175	Graph	5	x	sonic resonance		1552		0.0581			122.0				
175	Graph	5	x	sonic resonance		1620		0.0581			119.3				
175	Graph	5	x	sonic resonance		32		0.2124			86.2				
175	Graph	5	x	sonic resonance		101		0.2124			84.8				
175	Graph	5	x	sonic resonance		239		0.2124			84.1				
175	Graph	5	x	sonic resonance		396		0.2124			82.7				
175	Graph	5	x	sonic resonance		524		0.2124			80.7				
175	Graph	5	x	sonic resonance		652		0.2124			80				
175	Graph	5	x	sonic resonance		800		0.2124			78.6				
175	Graph	5	x	sonic resonance		918		0.2124			77.2				
175	Graph	5	x	sonic resonance		1036		0.2124			75.2				
175	Graph	5	x	sonic resonance		1125		0.2124			75.2				
175	Graph	5	x	sonic resonance		1203		0.2124			73.8				
175	Graph	5	x	sonic resonance		1262		0.2124			73.1				
175	Graph	5	x	sonic resonance		1321		0.2124			73.1				
175	Graph	5	x	sonic resonance		1390		0.2124			71.7				
175	Graph	5	x	sonic resonance		1440		0.2124			71.7				
175	Graph	5	x	sonic resonance		1528		0.2124			70.3				
175	Graph	5	x	sonic resonance		1636		0.2124			67.6				
175	Graph	5	x	sonic resonance		1666		0.2124			66.2				
177	Table	IV	x	ult.pulse echo	1	23	5.045		7.028	3.793	188.0	72.6	152.5	0.294	

Y_2O_3 { yttrium oxide, yttria }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
177	Table	IV	x	ult.pulse echo	2	23	5.011		6.968	3.746	182.4	70.3	149.5	0.297	
177	Table	IV	x	ult.pulse echo	3	23	5.030		6.941	3.678	177.6	68.0	151.6	0.305	
177	Table	IV	x	ult.pulse echo	4	23	5.001		6.927	3.704	178.4	68.6	148.5	0.300	
177	Table	IV	x	ult.pulse echo	5	23	5.003		6.870	3.657	174.3	66.9	146.9	0.302	
177	Table	IV	x	ult.pulse echo	6	23	5.028		6.852	3.696	177.9	68.7	144.5	0.295	
177	Table	IV	x	ult.pulse echo	7	23	4.882		6.151	3.235	133.7	51.1	116.6	0.309	
177	Table	IV	x	ult.pulse echo	8	23	4.816		6.550	3.551	156.9	60.7	125.6	0.292	
178	Table	III	x	Brillouin spectroscopy		22	5.033	0				66.3	150.8		
178	Table	III	x	Brillouin spectroscopy		22	5.033	0				66.0	148.0		
178	Table	III	x	Brillouin spectroscopy		200						65.5	147.5		
178	Table	III	x	Brillouin spectroscopy		400						64.8	144.3		
178	Table	III	x	Brillouin spectroscopy		600						62.7	141.8		
178	Table	III	x	Brillouin spectroscopy		800						61.5	137.1		
178	Table	III	x	Brillouin spectroscopy		800						60.3	137.2		
178	Table	III	x	Brillouin spectroscopy		1000						58.6	132.7		
178	Table	III	x	Brillouin spectroscopy		1200						56.8	129.8		

9.39 $Y_2O_3 \cdot xThO_2$ {yttrium oxide, yttria, Th-Y_2O_3, thoria doped yttria }

M_r / (g mol^{-1}) = 225.810+264.037x	Temperature range / (°C) = 25 to 1087	
ρ_{theo}{for 9 % ThO_2}/(g cm^{-3}) = 5.290	Porosity range = 0.0087 to 0.0087	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a



$Y_2O_3 \cdot xThO_2$ { yttria, Th-Y_2O_3, thoria-doped yttria }

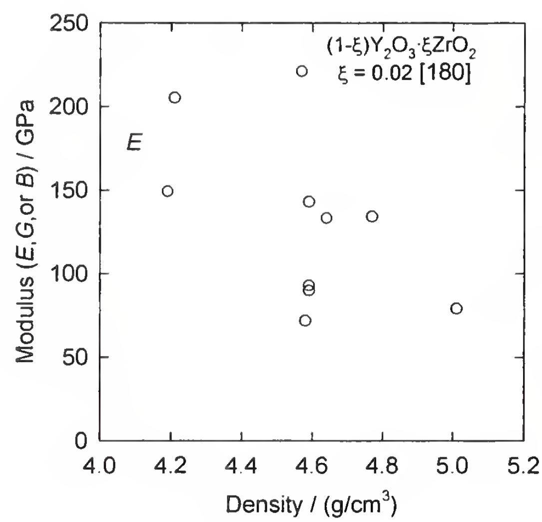
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
179	Table	I	x	resonance		25	5.244	0.0087			173.6	67.02		0.295	1
179	Table	I	x	resonance		100					172.3	66.54		0.295	1
179	Table	I	x	resonance		200					170.5	65.84		0.295	1
179	Table	I	x	resonance		300					168.5	65.08		0.295	1
179	Table	I	x	resonance		400					166.4	64.26		0.295	1
179	Table	I	x	resonance		500					164.3	63.40		0.295	1
179	Table	I	x	resonance		600					162.0	62.52		0.296	1
179	Table	I	x	resonance		700					159.8	61.62		0.297	1
179	Table	I	x	resonance		800					157.5	60.71		0.297	1
179	Table	I	x	resonance		900					155.3	59.82		0.298	1
179	Table	I	x	resonance		1000					153.0	58.95		0.298	1
179	Table	I	x	resonance		1087					151.1	58.22		0.298	1

Footnotes:

1: Reported composition (mole fraction): 91 % Y_2O_3 + 9 % ThO_2

9.40 $Y_2O_3 \cdot xZrO_2$ {yttrium oxide, yttria, Zr-Y_2O_3, zirconia doped yttria }

M_r / (g mol^{-1}) = 225.810+123.223x	Temperature range / (°C) = 23 to 23	
ρ_{theo}{for 2 % ZrO_2}/(g cm^{-3}) = 5.045	Porosity range = 0 to 0.17	
{ In the figure, x = ξ/(1-ξ) }	E_o / (GPa) = n/a a / (10^{-4}°C) = n/a n = n/a	B_o / (GPa) = n/a b / (10^{-4}°C) = n/a m = n/a



$Y_2O_3 \cdot xZrO_2$ { yttria, Zr-Y_2O_3, zirconia-doped yttria }

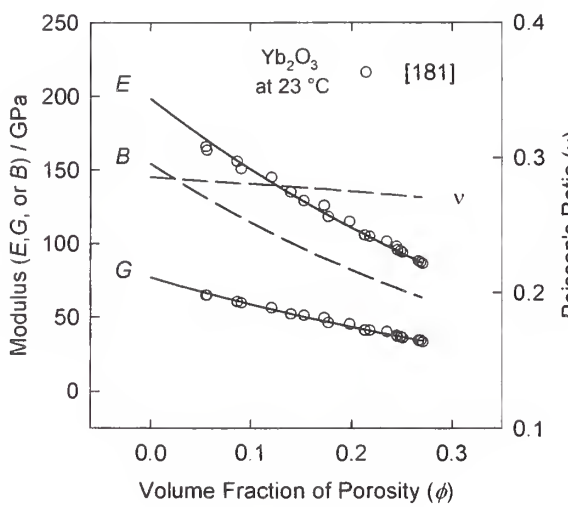
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
180	Table	II	x	dynamic		23	5.01				79				1
180	Table	II	x	dynamic		23	4.58				72				1
180	Table	II	x	dynamic		23	4.21				205			0.750	1
180	Table	II	x	dynamic		23	4.19				149			0.712	1
180	Table	II	x	dynamic		23	4.64				133			0.500	1
180	Table	II	x	dynamic		23	4.59				143	81		0.250	1
180	Table	II	x	sonic		23	4.59				93	37		0.263	1
180	Table	II	x	dynamic		23	4.59				90				1
180	Table	II	x	dynamic		23	4.77				134			0.400	1

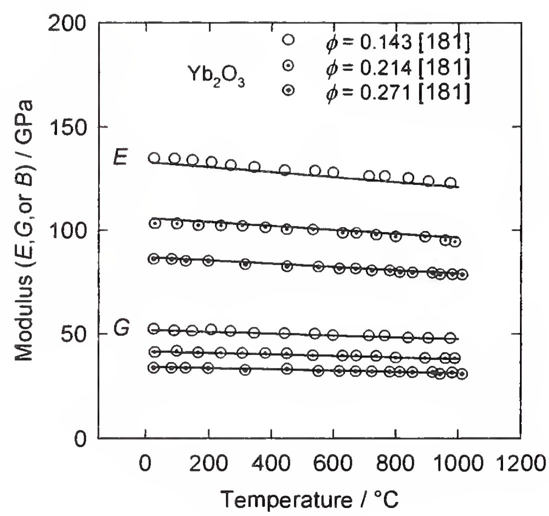
Footnotes:

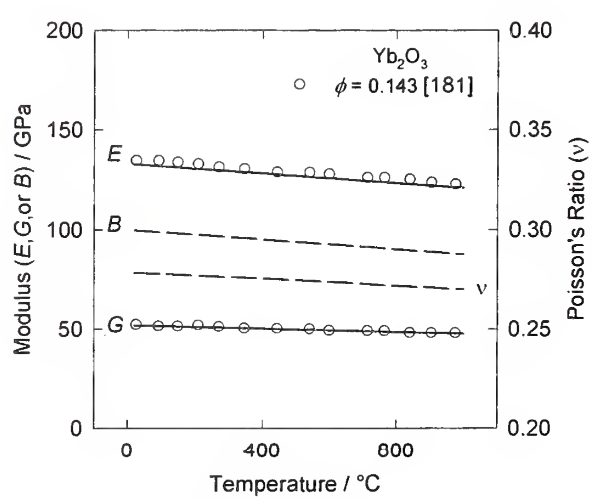
1: Reported composition (mass fraction): 98 % Y_2O_3 + 2 % ZrO_2

9.41 Yb_2O_3 { ytterbium oxide, ytterbia }

M_r / (g mol^{-1}) = 394.078	Temperature range / (°C) = 0 to 1000	
ρ_{theo} / (g cm^{-3}) = 9.2932	Porosity range = 0 to 0.27	
	E_o / (GPa) = 199	B_o / (GPa) = 155
	a / (10^{-4}°C) = 0.90	b / (10^{-4}°C) = 1.24
	n = 2.61	m = 2.83







Yb_2O_3 { ytterbium oxide, ytterbia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
181	Graph	1	x	sonic resonance		23		0.056			165.9	64.9		0.285	
181	Graph	1	x	sonic resonance		23		0.057			163.4	64.9		0.285	
181	Graph	1	x	sonic resonance		23		0.087			155.9	60.6		0.286	
181	Graph	1	x	sonic resonance		23		0.091			150.9	59.8		0.271	
181	Graph	1	x	sonic resonance		23		0.121			145.1	56.4		0.289	
181	Graph	1	x	sonic resonance		23		0.140			135.0	52.1		0.293	
181	Graph	1	x	sonic resonance		23		0.153			129.2	51.3		0.278	
181	Graph	1	x	sonic resonance		23		0.173			125.8	49.6		0.274	
181	Graph	1	x	sonic resonance		23		0.177			118.3	46.2		0.281	
181	Graph	1	x	sonic resonance		23		0.198			115.0	45.3		0.261	
181	Graph	1	x	sonic resonance		23		0.213			105.7	41.1		0.268	
181	Graph	1	x	sonic resonance		23		0.218			104.9	41.1		0.265	
181	Graph	1	x	sonic resonance		23		0.235			101.6	40.2		0.263	
181	Graph	1	x	sonic resonance		23		0.245			98.2	37.7		0.292	
181	Graph	1	x	sonic resonance		23		0.246			95.7	36.8		0.277	
181	Graph	1	x	sonic resonance		23		0.249			94.9	36.8		0.273	
181	Graph	1	x	sonic resonance		23		0.251			94.1	36.0		0.274	
181	Graph	1	x	sonic resonance		23		0.267			88.2	34.3		0.263	
181	Graph	1	x	sonic resonance		23		0.269			87.4	34.3		0.262	
181	Graph	1	x	sonic resonance		23		0.271			86.5	33.4		0.261	
181	Graph	2	x	sonic resonance		25		0.143			134.7	52.4		0.294	
181	Graph	2	x	sonic resonance		90		0.143			134.6	51.6			1
181	Graph	2	x	sonic resonance		146		0.143			133.8	51.5		0.292	
181	Graph	2	x	sonic resonance		207		0.143			133.0	52.1		0.290	
181	Graph	2	x	sonic resonance		269		0.143			131.4	51.3		0.289	
181	Graph	2	x	sonic resonance		345		0.143			130.5	50.4		0.289	
181	Graph	2	x	sonic resonance		443		0.143			128.9	50.3		0.286	
181	Graph	2	x	sonic resonance		540		0.143			128.7	50.1		0.288	
181	Graph	2	x	sonic resonance		598		0.143			127.9	49.3		0.290	
181	Graph	2	x	sonic resonance		713		0.143			126.2	49.1		0.290	
181	Graph	2	x	sonic resonance		764		0.143			126.1	49.1		0.289	
181	Graph	2	x	sonic resonance		840		0.143			125.3	48.2		0.288	

Yb_2O_3 { ytterbium oxide, ytterbia }															
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
181	Graph	2	x	sonic resonance		905		0.143			123.7	48.1		0.287	
181	Graph	2	x	sonic resonance		976		0.143			122.8	48.0		0.285	
181	Graph	2	x	sonic resonance		29		0.214			103.3	41.2		0.254	
181	Graph	2	x	sonic resonance		98		0.214			103.2	41.8		0.247	
181	Graph	2	x	sonic resonance		165		0.214			102.3	41.0		0.249	
181	Graph	2	x	sonic resonance		238		0.214			102.2	40.9		0.253	
181	Graph	2	x	sonic resonance		307		0.214			102.1	40.8		0.253	
181	Graph	2	x	sonic resonance		381		0.214			101.3	40.7		0.253	
181	Graph	2	x	sonic resonance		450		0.214			100.4	40.6		0.253	
181	Graph	2	x	sonic resonance		534		0.214			100.3	39.7		0.253	
181	Graph	2	x	sonic resonance		629		0.214			98.7	39.5		0.254	
181	Graph	2	x	sonic resonance		673		0.214			98.6	39.5		0.254	
181	Graph	2	x	sonic resonance		737		0.214			97.7	39.4		0.255	
181	Graph	2	x	sonic resonance		800		0.214			96.9	38.5		0.255	
181	Graph	2	x	sonic resonance		895		0.214			96.8	38.4		0.255	
181	Graph	2	x	sonic resonance		960		0.214			95.2	38.3		0.255	
181	Graph	2	x	sonic resonance		990		0.214			94.4	38.2		0.256	
181	Graph	2	x	sonic resonance		25		0.271			86.1	33.7		0.263	
181	Graph	2	x	sonic resonance		81		0.271			86.0	33.6		0.264	
181	Graph	2	x	sonic resonance		126		0.271			85.2	33.6		0.263	
181	Graph	2	x	sonic resonance		197		0.271			85.1	33.5		0.264	
181	Graph	2	x	sonic resonance		317		0.271			83.4	32.5		0.265	
181	Graph	2	x	sonic resonance		451		0.271			82.5	33.1		0.263	
181	Graph	2	x	sonic resonance		552		0.271			82.3	32.2		0.263	
181	Graph	2	x	sonic resonance		619		0.271			81.5	32.1		0.263	
181	Graph	2	x	sonic resonance		671		0.271			81.4	32.0		0.265	
181	Graph	2	x	sonic resonance		723		0.271			80.5	31.9		0.262	
181	Graph	2	x	sonic resonance		781		0.271			80.5	31.8		0.263	
181	Graph	2	x	sonic resonance		813		0.271			79.7	31.8		0.261	
181	Graph	2	x	sonic resonance		854		0.271			79.6	31.7		0.263	
181	Graph	2	x	sonic resonance		919		0.271			79.5	31.6		0.262	
181	Graph	2	x	sonic resonance		943		0.271			78.7	30.8		0.261	
181	Graph	2	x	sonic resonance		982		0.271			78.7	31.5		0.260	

Yb_2O_3 { ytterbium oxide, ytterbia }

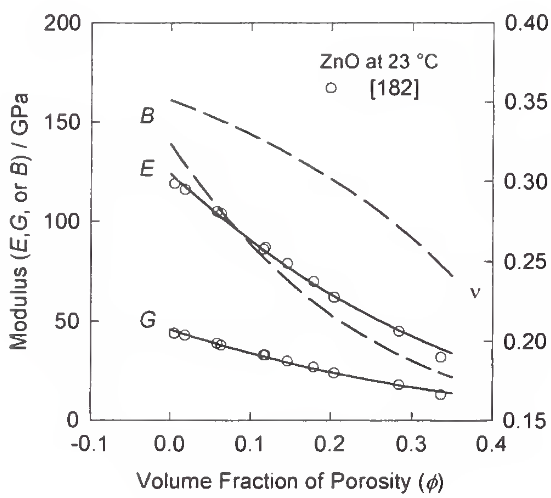
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
181	Graph	2	x	sonic resonance		1013		0.271			78.6	30.7		0.260	

Footnotes:

1: No value for Poisson's ratio was shown for this temperature in the figure.

9.42 ZnO { zinc oxide }

M_r / (g mol^{-1}) = 81.389	Temperature range / (°C) = 23 to 23	
ρ_{theo} / (g cm^{-3}) = 5.61	Porosity range = 0 to 0.4	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a



ZnO { zinc oxide }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
182	Graph	2	x	ult.pulse echo		23		0.005	5.85	2.81					
182	Graph	2	x	ult.pulse echo		23		0.018	5.77	2.80					
182	Graph	2	x	ult.pulse echo		23		0.058	5.50	2.73					
182	Graph	2	x	ult.pulse echo		23		0.063	5.42	2.69					
182	Graph	2	x	ult.pulse echo		23		0.116	4.92	2.57					
182	Graph	2	x	ult.pulse echo		23		0.118	4.95	2.57					
182	Graph	2	x	ult.pulse echo		23		0.146	4.75	2.55					
182	Graph	2	x	ult.pulse echo		23		0.179	4.44	2.45					
182	Graph	2	x	ult.pulse echo		23		0.204	4.21	2.32					
182	Graph	2	x	ult.pulse echo		23		0.284	3.65	2.11					
182	Graph	2	x	ult.pulse echo		23		0.336	3.18	1.89					
182	Graph	3	x	ult.pulse echo		23		0.005			119	44			
182	Graph	3	x	ult.pulse echo		23		0.018			116	43			
182	Graph	3	x	ult.pulse echo		23		0.058			105	39			
182	Graph	3	x	ult.pulse echo		23		0.063			104	38			
182	Graph	3	x	ult.pulse echo		23		0.116			86	33			
182	Graph	3	x	ult.pulse echo		23		0.118			87	33			
182	Graph	3	x	ult.pulse echo		23		0.146			79	30			
182	Graph	3	x	ult.pulse echo		23		0.179			70	27			
182	Graph	3	x	ult.pulse echo		23		0.204			62	24			
182	Graph	3	x	ult.pulse echo		23		0.284			45	18			
182	Graph	3	x	ult.pulse echo		23		0.336			32	13			
182	Graph	4	x	ult.pulse echo		23		0.005						0.351	
182	Graph	4	x	ult.pulse echo		23		0.018						0.348	
182	Graph	4	x	ult.pulse echo		23		0.058						0.337	
182	Graph	4	x	ult.pulse echo		23		0.063						0.334	
182	Graph	4	x	ult.pulse echo		23		0.116						0.310	
182	Graph	4	x	ult.pulse echo		23		0.118						0.314	
182	Graph	4	x	ult.pulse echo		23		0.146						0.299	
182	Graph	4	x	ult.pulse echo		23		0.179						0.284	
182	Graph	4	x	ult.pulse echo		23		0.204						0.278	
182	Graph	4	x	ult.pulse echo		23		0.284						0.240	

ZnO { zinc oxide }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
182	Graph	4	x	ult.pulse echo		23		0.336						0.223	
182	Graph	5	x	ult.pulse echo		23		0.005					134		
182	Graph	5	x	ult.pulse echo		23		0.018					128		
182	Graph	5	x	ult.pulse echo		23		0.058					105		
182	Graph	5	x	ult.pulse echo		23		0.063					102		
182	Graph	5	x	ult.pulse echo		23		0.116					76		
182	Graph	5	x	ult.pulse echo		23		0.118					79		
182	Graph	5	x	ult.pulse echo		23		0.146					67		
182	Graph	5	x	ult.pulse echo		23		0.179					53		
182	Graph	5	x	ult.pulse echo		23		0.204					46		
182	Graph	5	x	ult.pulse echo		23		0.284					29		
182	Graph	5	x	ult.pulse echo		23		0.336					20		
183	Graph	4a	x	sonic velocity		23		0.106			122				1
183	Graph	4a	x	sonic velocity		23		0.158			90				1
183	Graph	4a	x	sonic velocity		23		0.269			52				1
183	Graph	4a	x	sonic velocity		23		0.309			44				1
183	Graph	4a	x	sonic velocity		23		0.361			26				1
183	Graph	4a	x	sonic velocity		23		0.404			21				1
183	Graph	4b	x	sonic velocity		23		0.109			122				2
183	Graph	4b	x	sonic velocity		23		0.190			96				2
183	Graph	4b	x	sonic velocity		23		0.296			71				2
183	Graph	4b	x	sonic velocity		23		0.332			60				2

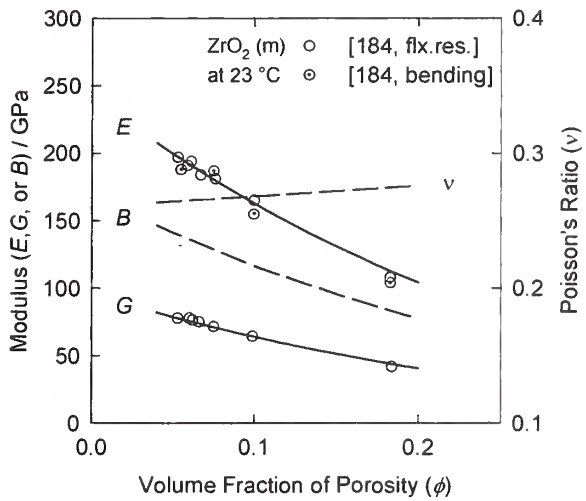
Footnotes:

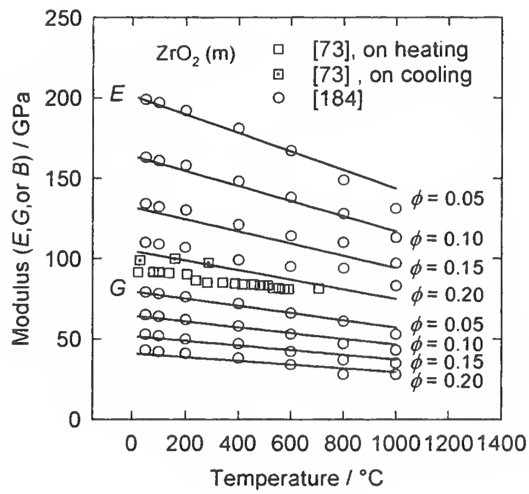
1: Process condition: constant time

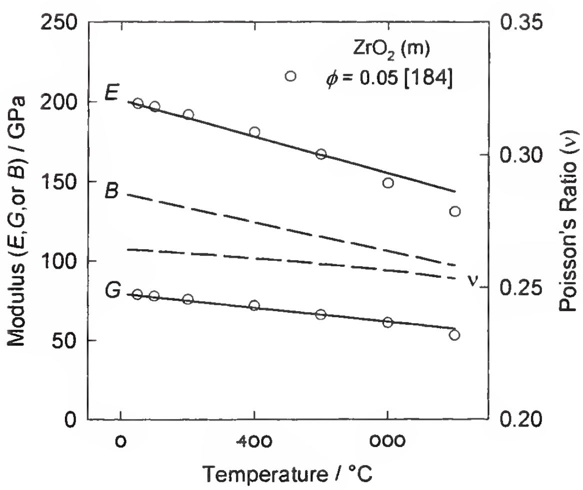
2: Process condition: constant power

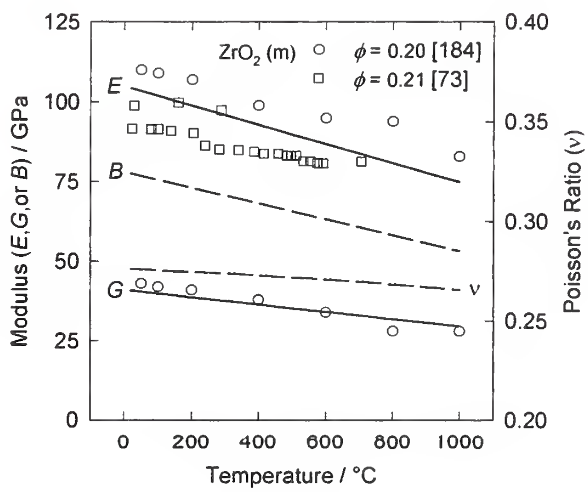
9.43 ZrO_2 (monoclinic) { zirconium dioxide, zirconia, ZrO_2 (m), monoclinic zirconia }

M_r / (g mol^{-1}) = 123.223	Temperature range / (°C) = 0 to 1000	
ρ_{theo} / (g cm^{-3}) = 5.6	Porosity range = 0 to 0.2	
	E_o / (GPa) = 244	B_o / (GPa) = 170
	a / (10^{-4}°C) = 2.86	b / (10^{-4}°C) = 3.19
	n = 3.79	m = 3.49









ZrO_2 (monoclinic) { zirconium dioxide, zirconia, ZrO_2(m), monoclinic zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
73	Graph	3	x	sonic resonance		24	4.41	0.21			91.6				1
73	Graph	3	x	sonic resonance		79					91.5				1
73	Graph	3	x	sonic resonance		100					91.5				1
73	Graph	3	x	sonic resonance		138					90.9				1
73	Graph	3	x	sonic resonance		205					90.2				1
73	Graph	3	x	sonic resonance		239					86.3				1
73	Graph	3	x	sonic resonance		281					85.1				1
73	Graph	3	x	sonic resonance		340					85.0				1
73	Graph	3	x	sonic resonance		386					84.4				1
73	Graph	3	x	sonic resonance		415					83.8				1
73	Graph	3	x	sonic resonance		458					83.8				1
73	Graph	3	x	sonic resonance		483					83.2				1
73	Graph	3	x	sonic resonance		496					83.2				1
73	Graph	3	x	sonic resonance		512					83.2				1
73	Graph	3	x	sonic resonance		533					81.5				1
73	Graph	3	x	sonic resonance		554					81.4				1
73	Graph	3	x	sonic resonance		575					80.9				1
73	Graph	3	x	sonic resonance		592					80.8				1
73	Graph	3	x	sonic resonance		706					81.3				1
73	Graph	3	x	sonic resonance		287					97.4				2
73	Graph	3	x	sonic resonance		160					99.8				2
73	Graph	3	x	sonic resonance		29					98.8				2
184	Graph	2	x	Flexural res.		25		0.053			197				
184	Graph	2	x	Flexural res.		25		0.059			191				
184	Graph	2	x	Flexural res.		25		0.061			194				
184	Graph	2	x	Flexural res.		25		0.067			184				
184	Graph	2	x	Flexural res.		25		0.076			181				
184	Graph	2	x	Flexural res.		25		0.100			165				
184	Graph	2	x	Flexural res.		25		0.183			108				
184	Graph	2	x	Torsional res.		25		0.053				77.9			
184	Graph	2	x	Torsional res.		25		0.060				77.9			

ZrO_2 (monoclinic) { zirconium dioxide, zirconia, ZrO_2(m), monoclinic zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
184	Graph	2	x	Torsional res.		25		0.062				76.5			
184	Graph	2	x	Torsional res.		25		0.066				75.2			
184	Graph	2	x	Torsional res.		25		0.075				71.7			
184	Graph	2	x	Torsional res.		25		0.099				64.5			
184	Graph	2	x	Torsional res.		25		0.184				41.9			
184	Graph	2	x	4-pt bending		25		0.055			188				
184	Graph	2	x	4-pt bending		25		0.075			187				
184	Graph	2	x	4-pt bending		25		0.100			155				
184	Graph	2	x	4-pt bending		25		0.183			104				
184	Table	III	s	Flexural res.		50		0.05			199				
184	Table	III	s	Flexural res.		50		0.10			163				
184	Table	III	s	Flexural res.		50		0.15			134				
184	Table	III	s	Flexural res.		50		0.20			110				
184	Table	III	s	Flexural res.		100		0.05			197				
184	Table	III	s	Flexural res.		100		0.10			161				
184	Table	III	s	Flexural res.		100		0.15			132				
184	Table	III	s	Flexural res.		100		0.20			109				
184	Table	III	s	Flexural res.		200		0.05			192				
184	Table	III	s	Flexural res.		200		0.10			158				
184	Table	III	s	Flexural res.		200		0.15			130				
184	Table	III	s	Flexural res.		200		0.20			107				
184	Table	III	s	Flexural res.		400		0.05			181				
184	Table	III	s	Flexural res.		400		0.10			148				
184	Table	III	s	Flexural res.		400		0.15			121				
184	Table	III	s	Flexural res.		400		0.20			99				
184	Table	III	s	Flexural res.		600		0.05			167				
184	Table	III	s	Flexural res.		600		0.10			138				
184	Table	III	s	Flexural res.		600		0.15			114				
184	Table	III	s	Flexural res.		600		0.20			95				
184	Table	III	s	Flexural res.		800		0.05			149				
184	Table	III	s	Flexural res.		800		0.10			128				
184	Table	III	s	Flexural res.		800		0.15			110				
184	Table	III	s	Flexural res.		800		0.20			94				

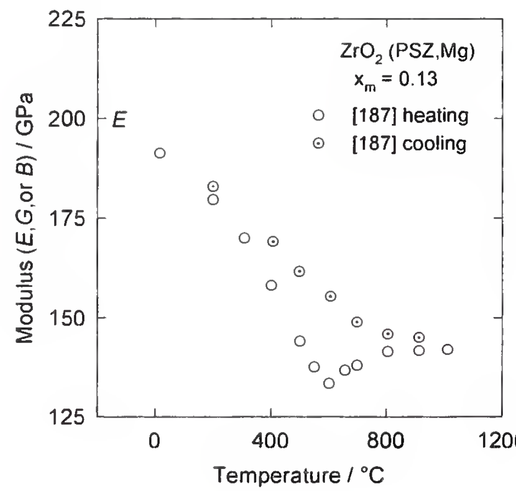
ZrO_2 (monoclinic) { zirconium dioxide, zirconia, ZrO_2(m), monoclinic zirconia }															
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
184	Table	III	s	Flexural res.		1000		0.05			131				
184	Table	III	s	Flexural res.		1000		0.10			113				
184	Table	III	s	Flexural res.		1000		0.15			97				
184	Table	III	s	Flexural res.		1000		0.20			83				
184	Table	III	s	Torsional res.		50		0.05				79			
184	Table	III	s	Torsional res.		50		0.10				65			
184	Table	III	s	Torsional res.		50		0.15				53			
184	Table	III	s	Torsional res.		50		0.20				43			
184	Table	III	s	Torsional res.		100		0.05				78			
184	Table	III	s	Torsional res.		100		0.10				64			
184	Table	III	s	Torsional res.		100		0.15				52			
184	Table	II	s	Torsional res.		100		0.20				42			
184	Table	II	s	Torsional res.		200		0.05				76			
184	Table	II	s	Torsional res.		200		0.10				62			
184	Table	II	s	Torsional res.		200		0.15				50			
184	Table	II	s	Torsional res.		200		0.20				41			
184	Table	II	s	Torsional res.		400		0.05				72			
184	Table	II	s	Torsional res.		400		0.10				58			
184	Table	II	s	Torsional res.		400		0.15				47			
184	Table	II	s	Torsional res.		400		0.20				38			
184	Table	II	s	Torsional res.		600		0.05				66			
184	Table	III	s	Torsional res.		600		0.10				53			
184	Table	III	s	Torsional res.		600		0.15				42			
184	Table	III	s	Torsional res.		600		0.20				34			
184	Table	III	s	Torsional res.		800		0.05				61			
184	Table	III	s	Torsional res.		800		0.10				47			
184	Table	III	s	Torsional res.		800		0.15				37			
184	Table	III	s	Torsional res.		800		0.20				28			
184	Table	III	s	Torsional res.		1000		0.05				53			
184	Table	III	s	Torsional res.		1000		0.10				43			
184	Table	III	s	Torsional res.		1000		0.15				35			
184	Table	III	s	Torsional res.		1000		0.20				28			

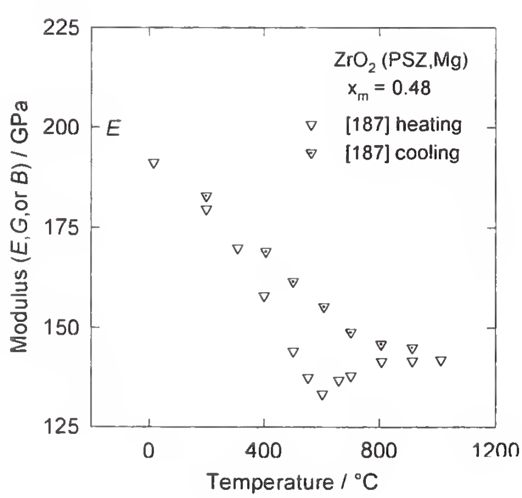
ZrO_2 (monoclinic) { zirconium dioxide, zirconia, ZrO_2(m), monoclinic zirconia }

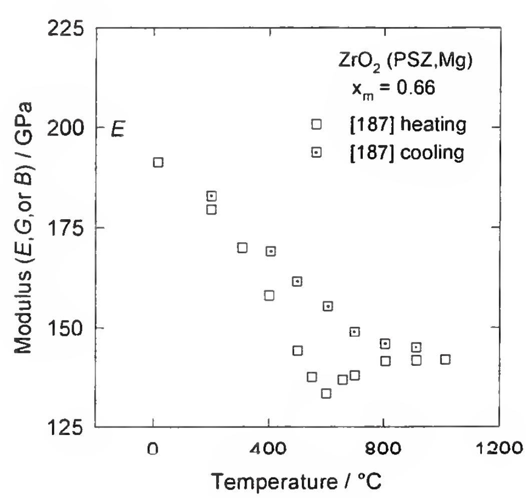
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
	--														
	Footnotes:														
		1: On heating													
		2: On cooling													

9.44 $ZrO_2 \cdot xMgO$ (partially stabilized) { zirconium dioxide, zirconia, Mg-ZrO_2 (PSZ), ZrO_2 (PSZ,Mg), magnesia partially stabilized zirconia }

M_r / (g mol^{-1}) = 123.223+40.304x	Temperature range / (°C) = 0 to 1000	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a	
{ N.B.: In the figures, x = $x_m/(1-x_m)$ }	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a







$ZrO_2 \cdot xMgO$ (partially stabilized) { zirconium dioxide, zirconia, Mg-PSZ, magnesia partially stabilized zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
187	Graph	3	x	flexural resonance	1	15					191.3				1,2,5
187	Graph	3	x	flexural resonance	1	200					179.6				1,2,5
187	Graph	3	x	flexural resonance	1	308					170.0				1,2,5
187	Graph	3	x	flexural resonance	1	401					158.1				1,2,5
187	Graph	3	x	flexural resonance	1	501					144.1				1,2,5
187	Graph	3	x	flexural resonance	1	552					137.6				1,2,5
187	Graph	3	x	flexural resonance	1	602					133.4				1,2,5
187	Graph	3	x	flexural resonance	1	658					136.8				1,2,5
187	Graph	3	x	flexural resonance	1	701					138.0				1,2,5
187	Graph	3	x	flexural resonance	1	807					141.5				1,2,5
187	Graph	3	x	flexural resonance	1	913					141.7				1,2,5
187	Graph	3	x	flexural resonance	1	1012					141.9				1,2,5
187	Graph	3	x	flexural resonance	1	913					145.0				1,2,6
187	Graph	3	x	flexural resonance	1	806					145.9				1,2,6
187	Graph	3	x	flexural resonance	1	700					148.9				1,2,6
187	Graph	3	x	flexural resonance	1	607					155.3				1,2,6
187	Graph	3	x	flexural resonance	1	500					161.6				1,2,6
187	Graph	3	x	flexural resonance	1	407					169.1				1,2,6
187	Graph	3	x	flexural resonance	1	200					182.9				1,2,6
187	Graph	4	x	flexural resonance	2	21					195.7				1,3,5
187	Graph	4	x	flexural resonance	2	211					188.3				1,3,5
187	Graph	4	x	flexural resonance	2	310					174.4				1,3,5
187	Graph	4	x	flexural resonance	2	409					161.5				1,3,5
187	Graph	4	x	flexural resonance	2	508					147.6				1,3,5
187	Graph	4	x	flexural resonance	2	529					145.4				1,3,5
187	Graph	4	x	flexural resonance	2	551					142.2				1,3,5
187	Graph	4	x	flexural resonance	2	564					142.2				1,3,5
187	Graph	4	x	flexural resonance	2	586					140.1				1,3,5
187	Graph	4	x	flexural resonance	2	600					141.2				1,3,5
187	Graph	4	x	flexural resonance	2	620					143.4				1,3,5
187	Graph	4	x	flexural resonance	2	662					152.1				1,3,5
187	Graph	4	x	flexural resonance	2	703					158.6				1,3,5

$ZrO_2 \cdot xMgO$ (partially stabilized) { zirconium dioxide, zirconia, Mg-PSZ, magnesia partially stabilized zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
187	Graph	4	x	flexural resonance	2	808					162.0				1,3,5
187	Graph	4	x	flexural resonance	2	898					163.1				1,3,5
187	Graph	4	x	flexural resonance	2	1003					161.1				1,3,5
187	Graph	4	x	flexural resonance	2	898					167.5				1,3,6
187	Graph	4	x	flexural resonance	2	807					168.4				1,3,6
187	Graph	4	x	flexural resonance	2	702					173.7				1,3,6
187	Graph	4	x	flexural resonance	2	604					173.6				1,3,6
187	Graph	4	x	flexural resonance	2	506					176.8				1,3,6
187	Graph	4	x	flexural resonance	2	400					178.8				1,3,6
187	Graph	4	x	flexural resonance	2	211					186.2				1,3,6
187	Graph	5	x	flexural resonance	3	21					195.7				1,4,5
187	Graph	5	x	flexural resonance	3	211					188.3				1,4,5
187	Graph	5	x	flexural resonance	3	310					174.4				1,4,5
187	Graph	5	x	flexural resonance	3	409					161.5				1,4,5
187	Graph	5	x	flexural resonance	3	508					147.6				1,4,5
187	Graph	5	x	flexural resonance	3	529					145.4				1,4,5
187	Graph	5	x	flexural resonance	3	551					142.2				1,4,5
187	Graph	5	x	flexural resonance	3	564					142.2				1,4,5
187	Graph	5	x	flexural resonance	3	586					140.1				1,4,5
187	Graph	5	x	flexural resonance	3	600					141.2				1,4,5
187	Graph	5	x	flexural resonance	3	620					143.4				1,4,5
187	Graph	5	x	flexural resonance	3	662					152.1				1,4,5
187	Graph	5	x	flexural resonance	3	703					158.6				1,4,5
187	Graph	5	x	flexural resonance	3	808					162.0				1,4,5
187	Graph	5	x	flexural resonance	3	898					163.1				1,4,5
187	Graph	5	x	flexural resonance	3	1003					161.1				1,4,5
187	Graph	5	x	flexural resonance	3	898					167.5				1,4,6
187	Graph	5	x	flexural resonance	3	807					168.4				1,4,6
187	Graph	5	x	flexural resonance	3	702					173.7				1,4,6
187	Graph	5	x	flexural resonance	3	604					173.6				1,4,6
187	Graph	5	x	flexural resonance	3	506					176.8				1,4,6
187	Graph	5	x	flexural resonance	3	400					178.8				1,4,6
187	Graph	5	x	flexural resonance	3	211					186.2				1,4,6

$ZrO_2 \cdot xMgO$ (partially stabilized) { zirconium dioxide, zirconia, Mg-PSZ, magnesia partially stabilized zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
188	Table	1	x	ultrasonic velocity		23	5.36				213			0.25	7
188	Table	1	x	ultrasonic velocity		23	4.98				187			0.14	7
188	Table	1	x	ultrasonic velocity		23	4.97				199			0.18	7
188	Table	1	x	ultrasonic velocity		23	4.65				155			0.26	7
188	Table	1	x	ultrasonic velocity		23	4.56				161			0.19	7
188	Table	1	x	ultrasonic velocity		23	4.34				124			0.20	7
188	Table	1	x	ultrasonic velocity		23	4.22				131			0.19	7
188	Table	1	x	ultrasonic velocity		23	3.93				83.6			0.22	7
188	Table	1	x	ultrasonic velocity		23	3.80				85.8			0.21	7
188	Table	1	x	ultrasonic velocity		23	3.67				88.7			0.20	7

Footnotes:

1: Reported composition (mole fraction): 91 % ZrO_2 + 9 % MgO

2: Reported mass fraction monoclinic phase = 13 %

3: Reported mass fraction monoclinic phase = 48 %

4: Reported mass fraction monoclinic phase = 66 %

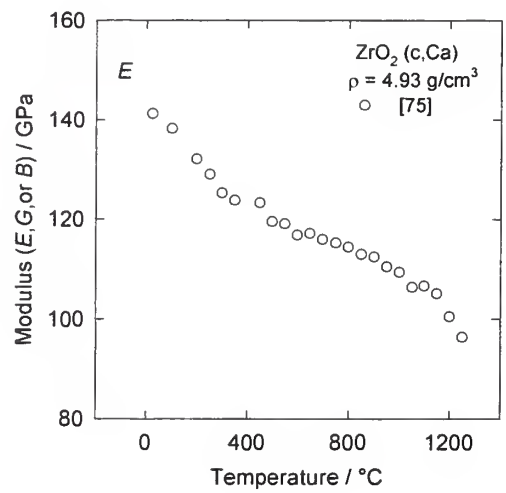
5: On heating

6: On cooling

7: Reported composition (mass fraction): 96.4 % ZrO_2 + 3.6 % MgO

9.45 $ZrO_2 \cdot xCaO$ (cubic) { zirconium dioxide, zirconia, Ca-ZrO_2 (c), ZrO_2 (c,Ca), calcia stabilized cubic zirconia }

M_r / (g mol^{-1}) = 123.223+56.077x	Temperature range / (°C) = 23 to 1250	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a	
N.B.: {See also section 9.50 with all X-ZrO_2(c) data grouped together.}	E_o / (GPa) = n/a a / (10^{-4}°C) = n/a n = na/	B_o / (GPa) = n/a b / (10^{-4}°C) = n/a m = n/a



$ZrO_2 \cdot xCaO$ (cubic) { zirconium dioxide, zirconia, Ca-ZrO_2(c), Ca-stabilized cubic zirconia }

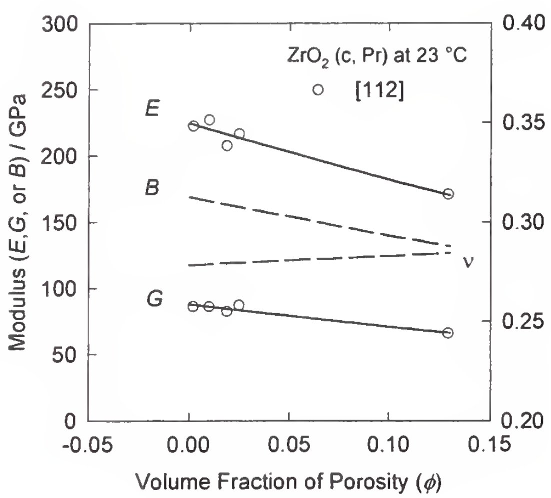
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
75	Table	II	x	sonic resonance		23	4.93				141.0				1
75	Graph	4	x	sonic resonance		23	4.93				141.3				1
75	Graph	4	x	sonic resonance		100					138.3				1
75	Graph	4	x	sonic resonance		200					132.2				1
75	Graph	4	x	sonic resonance		250					129.1				1
75	Graph	4	x	sonic resonance		300					125.3				1
75	Graph	4	x	sonic resonance		350					123.8				1
75	Graph	4	x	sonic resonance		450					123.3				1
75	Graph	4	x	sonic resonance		500					119.5				1
75	Graph	4	x	sonic resonance		550					119.1				1
75	Graph	4	x	sonic resonance		600					116.8				1
75	Graph	4	x	sonic resonance		650					117.2				1
75	Graph	4	x	sonic resonance		700					116.0				1
75	Graph	4	x	sonic resonance		750					115.2				1
75	Graph	4	x	sonic resonance		800					114.4				1
75	Graph	4	x	sonic resonance		850					112.9				1
75	Graph	4	x	sonic resonance		900					112.4				1
75	Graph	4	x	sonic resonance		950					110.5				1
75	Graph	4	x	sonic resonance		1000					109.3				1
75	Graph	4	x	sonic resonance		1050					106.3				1
75	Graph	4	x	sonic resonance		1100					106.6				1
75	Graph	4	x	sonic resonance		1150					105.1				1
75	Graph	4	x	sonic resonance		1200					100.5				1
75	Graph	4	x	sonic resonance		1250					96.4				1

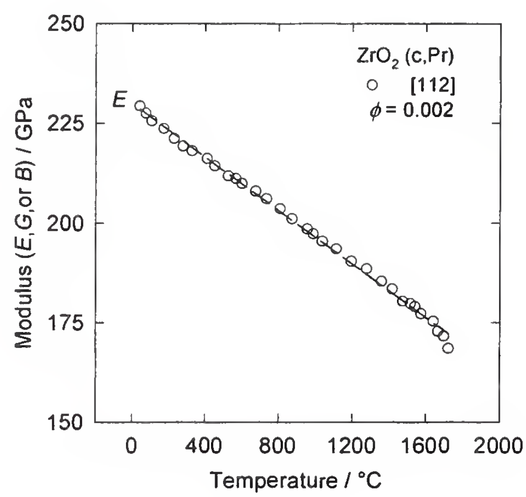
Footnotes:

1: Reported composition (mole fraction): 95 % ZrO_2 + 5 % CaO

9.46 $ZrO_2 \cdot xPr_2O_3$ (cubic) { zirconium dioxide, zirconia, Pr-ZrO_2 (c), ZrO_2 (c,Pr), praseodymia stabilized cubic zirconia }

M_r / (g mol^{-1}) = 123.223+329.814x	Temperature range / (°C) = 23 to 1721	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.13	
N.B.: {See also section 9.50 with all X-ZrO_2(c) data grouped together.}	E_o / (GPa) = n/a a / (10^{-4}°C) = n/a n = na/	B_o / (GPa) = n/a b / (10^{-4}°C) = n/a m = n/a





$ZrO_2 \cdot xPr_2O_3$ (cubic) { zirconium dioxide, zirconia, Pr-ZrO_2(c), Pr-stabilized cubic zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
112	Graph	1	x	sonic resonance		23		0.002			222.5	86.2			1
112	Graph	1	x	sonic resonance		23		0.010			227.1	86.1			1
112	Graph	1	x	sonic resonance		23		0.019			207.1	82.5			1
112	Graph	1	x	sonic resonance		23		0.025			216.4	87.1			1
112	Graph	1	x	sonic resonance		23		0.129			170.8	65.9			1
112	Graph	2	x	sonic resonance		41		0.002			229.3				1
112	Graph	2	x	sonic resonance		74		0.002			227.5				1
112	Graph	2	x	sonic resonance		107		0.002			225.6				1
112	Graph	2	x	sonic resonance		173		0.002			223.7				1
112	Graph	2	x	sonic resonance		230		0.002			221.2				1
112	Graph	2	x	sonic resonance		280		0.002			219.3				1
112	Graph	2	x	sonic resonance		329		0.002			218.1				1
112	Graph	2	x	sonic resonance		412		0.002			216.2				1
112	Graph	2	x	sonic resonance		453		0.002			214.3				1
112	Graph	2	x	sonic resonance		527		0.002			211.8				1
112	Graph	2	x	sonic resonance		569		0.002			211.1				1
112	Graph	2	x	sonic resonance		602		0.002			209.9				1
112	Graph	2	x	sonic resonance		676		0.002			208.0				1
112	Graph	2	x	sonic resonance		734		0.002			206.1				1
112	Graph	2	x	sonic resonance		808		0.002			203.6				1
112	Graph	2	x	sonic resonance		874		0.002			201.1				1
112	Graph	2	x	sonic resonance		956		0.002			198.5				1
112	Graph	2	x	sonic resonance		989		0.002			197.3				1
112	Graph	2	x	sonic resonance		1038		0.002			195.4				1
112	Graph	2	x	sonic resonance		1113		0.002			193.5				1
112	Graph	2	x	sonic resonance		1195		0.002			190.4				1
112	Graph	2	x	sonic resonance		1278		0.002			188.5				1
112	Graph	2	x	sonic resonance		1360		0.002			185.3				1
112	Graph	2	x	sonic resonance		1418		0.002			183.4				1
112	Graph	2	x	sonic resonance		1475		0.002			180.3				1
112	Graph	2	x	sonic resonance		1517		0.002			179.7				1
112	Graph	2	x	sonic resonance		1541		0.002			179.0				1

$ZrO_2 \cdot xPr_2O_3$ (cubic) { zirconium dioxide, zirconia, Pr-ZrO_2(c), Pr-stabilized cubic zirconia }

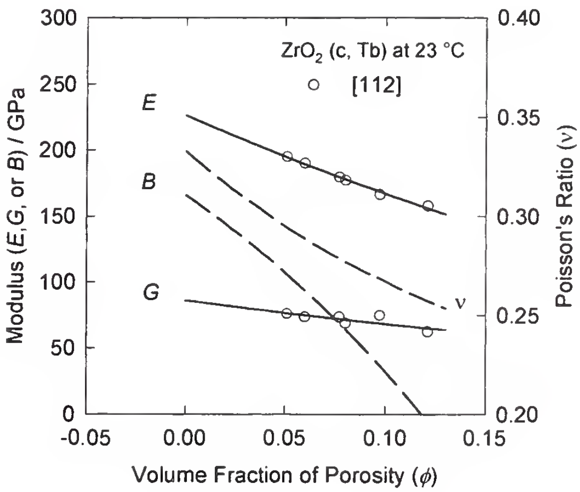
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
112	Graph	2	x	sonic resonance		1574		0.002			177.2				1
112	Graph	2	x	sonic resonance		1640		0.002			175.3				1
112	Graph	2	x	sonic resonance		1664		0.002			172.8				1
112	Graph	2	x	sonic resonance		1697		0.002			171.6				1
112	Graph	2	x	sonic resonance		1721		0.002			168.5				1

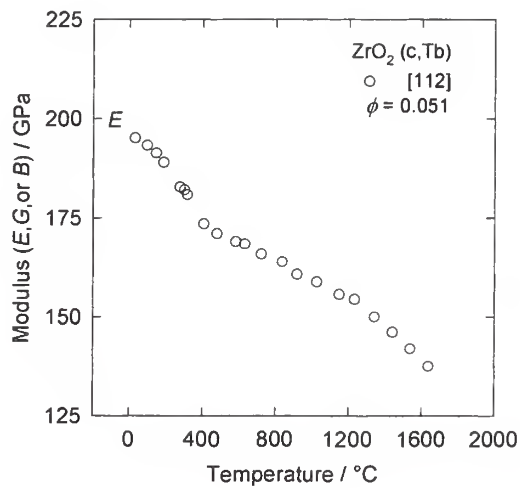
Footnotes:

1: Reported composition (mole fraction): 66.7 % ZrO_2 + 33.3 % Pr_2O_3

9.47 $ZrO_2 \cdot xTb_2O_3$ (cubic) { zirconium dioxide, zirconia, Tb-ZrO_2 (c), ZrO_2 (c,Tb), terbia stabilized cubic zirconia }

M_r / (g mol^{-1}) = 123.223+365.849x	Temperature range / (°C) = 23 to 1636	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.12	
N.B.: {See also section 9.50 with all X-ZrO_2(c) data grouped together.}	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = na/	m = n/a





$ZrO_2 \cdot xTb_2O_3$ (cubic) { zirconium dioxide, zirconia, Tb-ZrO_2(c), Tb-stabilized cubic zirconia }

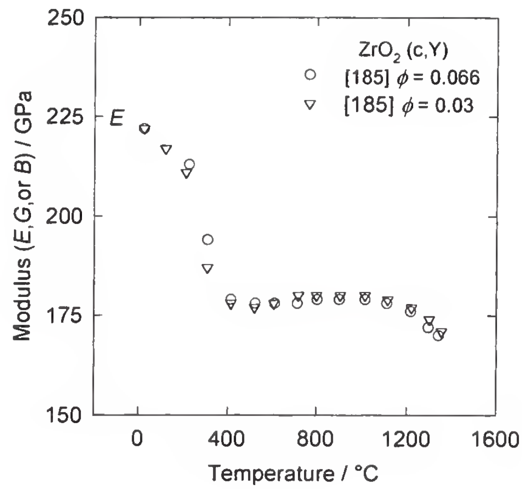
Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
112	Graph	1	x	sonic resonance		23		0.051			195.1	76.2			1
112	Graph	1	x	sonic resonance		23		0.060			190.3	73.8			1
112	Graph	1	x	sonic resonance		23		0.077			179.6	73.6			1
112	Graph	1	x	sonic resonance		23		0.080			177.2	68.9			1
112	Graph	1	x	sonic resonance		23		0.097			166.5	74.5			1
112	Graph	1	x	sonic resonance		23		0.121			158.0	62.5			1
112	Graph	2	x	sonic resonance		30		0.051			195.2				1
112	Graph	2	x	sonic resonance		96		0.051			193.3				1
112	Graph	2	x	sonic resonance		145		0.051			191.4				1
112	Graph	2	x	sonic resonance		186		0.051			189.0				1
112	Graph	2	x	sonic resonance		276		0.051			182.8				1
112	Graph	2	x	sonic resonance		301		0.051			182.1				1
112	Graph	2	x	sonic resonance		317		0.051			180.9				1
112	Graph	2	x	sonic resonance		406		0.051			173.5				1
112	Graph	2	x	sonic resonance		480		0.051			171.0				1
112	Graph	2	x	sonic resonance		580		0.051			169.0				1
112	Graph	2	x	sonic resonance		629		0.051			168.4				1
112	Graph	2	x	sonic resonance		720		0.051			165.9				1
112	Graph	2	x	sonic resonance		836		0.051			163.9				1
112	Graph	2	x	sonic resonance		919		0.051			160.8				1
112	Graph	2	x	sonic resonance		1026		0.051			158.8				1
112	Graph	2	x	sonic resonance		1150		0.051			155.7				1
112	Graph	2	x	sonic resonance		1233		0.051			154.4				1
112	Graph	2	x	sonic resonance		1340		0.051			150.0				1
112	Graph	2	x	sonic resonance		1439		0.051			146.2				1
112	Graph	2	x	sonic resonance		1537		0.051			141.9				1
112	Graph	2	x	sonic resonance		1636		0.051			137.5				1

Footnotes:

1: Reported composition (mole fraction): 66.7 % ZrO_2 + 33.3 % Tb_2O_3

9.48 $ZrO_2 \cdot xY_2O_3$ (cubic) { zirconium dioxide, zirconia, Y-ZrO_2 (c), ZrO_2 (c,Y), yttria stabilized cubic zirconia }

M_r / (g mol^{-1}) = 123.223+225.810x	Temperature range / (°C) = 0 to 1600	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.2	
N.B.: {See also section 9.50 with all X-ZrO_2(c) data grouped together.}	E_o / (GPa) = n/a a / (10^{-4}°C) = n/a n = na/	B_o / (GPa) = n/a b / (10^{-4}°C) = n/a m = n/a



$ZrO_2 \cdot xY_2O_3$ { zirconium dioxide, zirconia, Y-ZrO_2(c), Y-stabilized cubic zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm^3	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
185	Text	904	x	ultrasonic resonance	1	23	5.802				222				1
185	Graph	2	x	ultrasonic resonance	1	23	5.802				222				1
185	Graph	2	x	ultrasonic resonance	1	225					213				1
185	Graph	2	x	ultrasonic resonance	1	308					194				1
185	Graph	2	x	ultrasonic resonance	1	413					179				1
185	Graph	2	x	ultrasonic resonance	1	523					178				1
185	Graph	2	x	ultrasonic resonance	1	612					178				1
185	Graph	2	x	ultrasonic resonance	1	714					178				1
185	Graph	2	x	ultrasonic resonance	1	802					179				1
185	Graph	2	x	ultrasonic resonance	1	900					179				1
185	Graph	2	x	ultrasonic resonance	1	1014					179				1
185	Graph	2	x	ultrasonic resonance	1	1111					178				1
185	Graph	2	x	ultrasonic resonance	1	1217					176				1
185	Graph	2	x	ultrasonic resonance	1	1297					172				1
185	Graph	2	x	ultrasonic resonance	1	1343					170				1
185	Text	904	x	ultrasonic resonance	2	23	5.878				223				2
185	Graph	2	x	ultrasonic resonance	2	23	5.878				222				2
185	Graph	2	x	ultrasonic resonance	2	120					217				2
185	Graph	2	x	ultrasonic resonance	2	212					211				2
185	Graph	2	x	ultrasonic resonance	2	308					187				2
185	Graph	2	x	ultrasonic resonance	2	413					178				2
185	Graph	2	x	ultrasonic resonance	2	519					177				2
185	Graph	2	x	ultrasonic resonance	2	608					178				2
185	Graph	2	x	ultrasonic resonance	2	718					180				2
185	Graph	2	x	ultrasonic resonance	2	798					180				2
185	Graph	2	x	ultrasonic resonance	2	904					180				2
185	Graph	2	x	ultrasonic resonance	2	1014					180				2
185	Graph	2	x	ultrasonic resonance	2	1115					179				2
185	Graph	2	x	ultrasonic resonance	2	1221					177				2
185	Graph	2	x	ultrasonic resonance	2	1301					174				2
185	Graph	2	x	ultrasonic resonance	2	1356					171				2

$ZrO_2 \cdot xY_2O_3$ { zirconium dioxide, zirconia, Y-ZrO_2(c), Y-stabilized cubic zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
	--														

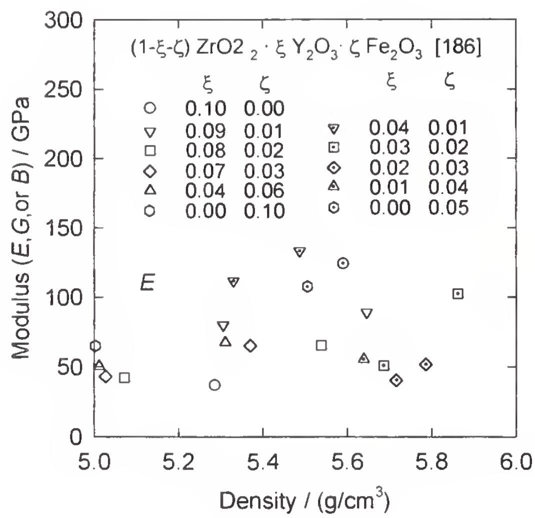
Footnotes:

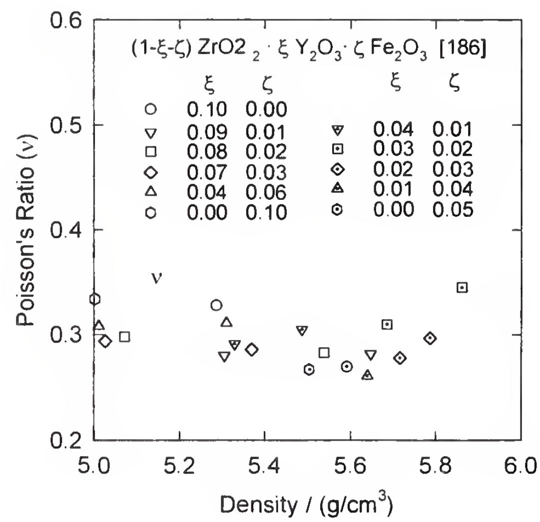
1: Reported composition (mole fraction): 93.5 % ZrO_2 + 6.5 % Y_2O_3. Relative density was reported as 0.934

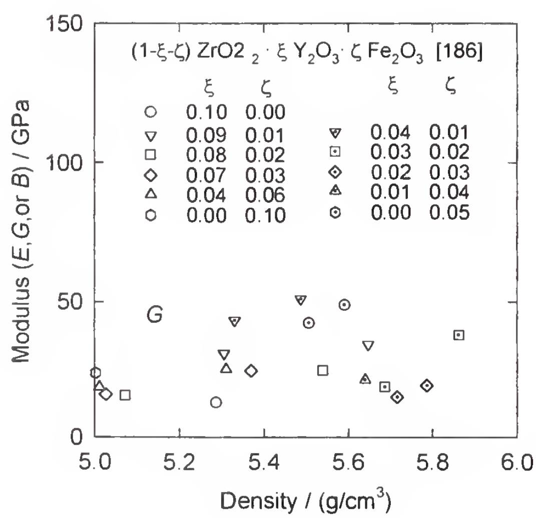
2: Reported composition (mole fraction): 93.5 % ZrO_2 + 6.5 % Y_2O_3. Relative density was reported as 0.97

9.49 $ZrO_2 \cdot xY_2O_3 \cdot yFe_2O_3$ (cubic) { zirconium dioxide, zirconia, Y,Fe-ZrO_2 (c), ZrO_2 (c,Y,Fe), yttria stabilized (iron doped) cubic zirconia }

M_r / (g mol^{-1}) = 123.223+225.810x+159.688y	Temperature range / (°C) = 23 to 23	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a	
{ N.B.: In the figures, $x = \xi/(1-\xi-\zeta)$, $y = \zeta/(1-\xi-\zeta)$ }	E_o / (GPa) = n/a a / (10^{-4}°C) = n/a n = na/	B_o / (GPa) = n/a b / (10^{-4}°C) = n/a m = n/a







$ZrO_2 \cdot xY_2O_3 \cdot yFe_2O_3$ (cubic) { zirconia, Y,Fe-ZrO_2(c), Y,Fe-stabilized cubic zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
186	Table	I	x	ult. pulse echo	1	23	5.2872		3.205	1.620	36.9	13.9	35.8	0.328	1
186	Table	I	x	ult. pulse echo	2	23	5.3057		4.398	2.430	80.1	31.3	60.9	0.280	2
186	Table	I	x	ult. pulse echo	3	23	5.0711		3.345	1.794	42.3	16.3	35.0	0.298	3
186	Table	I	x	ult. pulse echo	4	23	5.0262		3.380	1.825	43.2	16.7	35.1	0.294	4
186	Table	I	x	ult. pulse echo	5	23	5.0110		3.720	1.960	50.5	19.3	43.6	0.308	5
186	Table	I	x	ult. pulse echo	6	23	5.0024		4.418	2.208	65.1	24.4	65.1	0.334	6
186	Table	I	x	ult. pulse echo	7	23	5.0200		---	---	---	---	---	---	7
186	Table	I	x	ult. pulse echo	8	23	5.3303		5.248	2.849	111.8	43.3	89.1	0.291	8
186	Table	I	x	ult. pulse echo	9	23	5.6870		3.531	1.852	51.1	19.5	44.9	0.310	9
186	Table	I	x	ult. pulse echo	10	23	5.7175		3.011	1.670	40.6	15.9	30.6	0.278	10
186	Table	I	x	ult. pulse echo	11	23	5.6398		3.475	1.975	55.5	22.0	38.8	0.261	11
186	Table	I	x	ult. pulse echo	12	23	5.5051		4.926	2.777	107.7	42.5	76.9	0.267	12
186	Table	II	x	ult. pulse echo	1	23	5.6601		---	---	---	---	---	---	1
186	Table	II	x	ult. pulse echo	2	23	5.6474		4.502	2.481	89.2	34.8	68.1	0.282	2
186	Table	II	x	ult. pulse echo	3	23	5.5385		3.891	2.142	65.2	25.4	49.9	0.283	3
186	Table	II	x	ult. pulse echo	4	23	5.3700		3.975	2.175	65.3	25.4	40.9	0.286	4
186	Table	II	x	ult. pulse echo	5	23	5.3109		4.210	2.203	67.6	25.8	59.7	0.311	5
186	Table	II	x	ult. pulse echo	6	23	5.3060		---	---	---	---	---	---	6
186	Table	II	x	ult. pulse echo	7	23	5.1470		---	---	---	---	---	---	7
186	Table	II	x	ult. pulse echo	8	23	5.4875		5.763	3.052	133.4	51.1	114.2	0.305	8
186	Table	II	x	ult. pulse echo	9	23	5.8622		5.267	2.550	102.5	38.1	111.8	0.345	9
186	Table	II	x	ult. pulse echo	10	23	5.7870		3.459	1.859	51.9	20.0	42.5	0.297	10
186	Table	II	x	ult. pulse echo	11	23	---		---	---	---	---	---	---	11
186	Table	II	x	ult. pulse echo	12	23	5.5905		5.275	2.961	124.5	49.0	90.3	0.270	12

Footnotes:

1: Reported composition (mole fraction): 90 % ZrO_2 + 10 % Y_2O_3

2: Reported composition (mole fraction): 90 % ZrO_2 + 9 % Y_2O_3 + 1 % Fe_2O_3

3: Reported composition (mole fraction): 90 % ZrO_2 + 8 % Y_2O_3 + 2 % Fe_2O_3

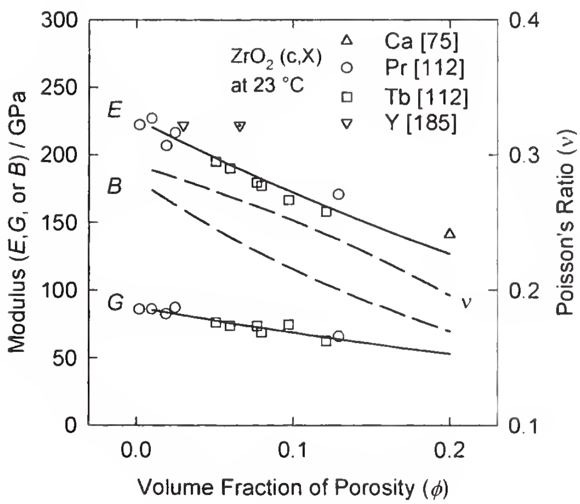
4: Reported composition (mole fraction): 90 % ZrO_2 + 7 % Y_2O_3 + 3 % Fe_2O_3

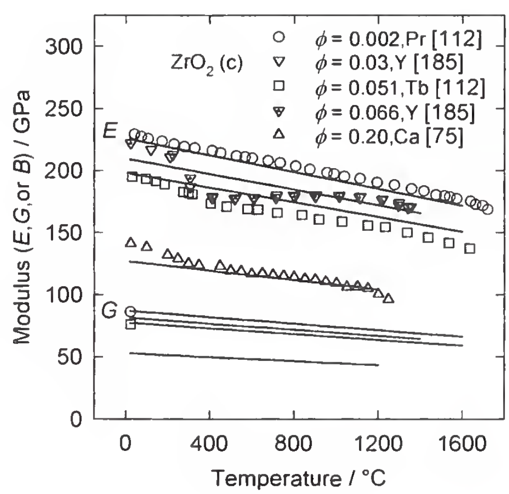
$ZrO_2 \cdot xY_2O_3 \cdot yFe_2O_3$ (cubic) { zirconia, Y,Fe-ZrO_2(c), Y,Fe-stabilized cubic zirconia }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
		5 Reported composition (mole fraction): 90 % ZrO_2 + 4 % Y_2O_3 + 6 % Fe_2O_3													
		6 Reported composition (mole fraction): 90 % ZrO_2 + 10 % Fe_2O_3													
		7 Reported composition (mole fraction): 95 % ZrO_2 + 5 % Y_2O_3													
		8 Reported composition (mole fraction): 95 % ZrO_2 + 4 % Y_2O_3 + 1 % Fe_2O_3													
		9 Reported composition (mole fraction): 95 % ZrO_2 + 3 % Y_2O_3 + 2 % Fe_2O_3													
		10: Reported composition (mole fraction): 95 % ZrO_2 + 2 % Y_2O_3 + 3 % Fe_2O_3													
		11: Reported composition (mole fraction): 95 % ZrO_2 + 1 % Y_2O_3 + 4 % Fe_2O_3													
		12: Reported composition (mole fraction): 95 % ZrO_2 + 5 % Fe_2O_3													

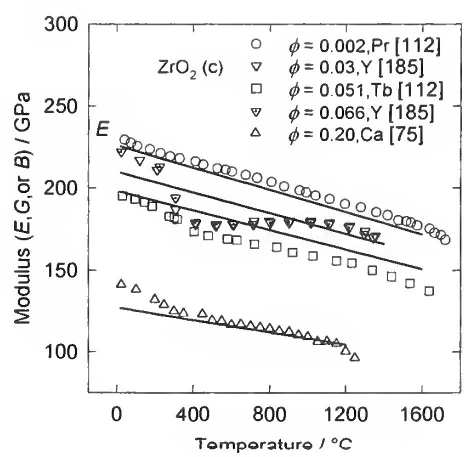
9.50 $ZrO_2 \cdot xX_2O_3$ (cubic) { zirconium dioxide, zirconia, X-ZrO_2 (c), ZrO_2 (c,X), X stabilized cubic zirconia }

M_r / (g mol^{-1}) = 123.223+M_xx	Temperature range / (°C) = 0 to 1600	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.2	
N.B.: {All X-ZrO_2 (c) data were grouped together to estimate the parameters}	E_o / (GPa) = {227} a / (10^{-4}°C) = {1.50} n = {2.59}	B_o / (GPa) = {183} b / (10^{-4}°C) = {1.48} m = {4.31}



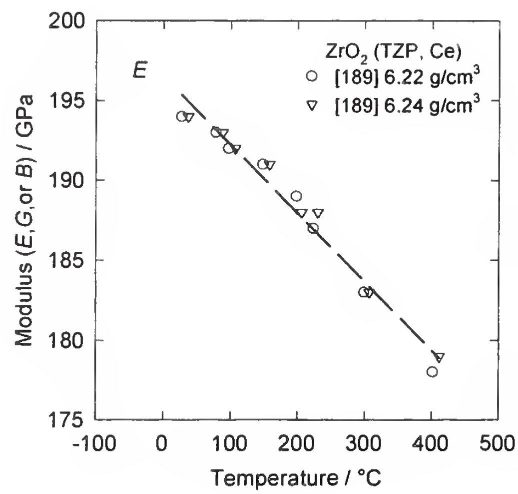


For data listings, see the separate listings for $ZrO_2 \cdot xX_2O_3$ (cubic), where X = Ca, Pr, Tb, or Y.



9.51 $ZrO_2 \cdot xCeO_2$ (tetragonal) { zirconium dioxide, zirconia, Ce-ZrO_2 (TZP), ZrO_2 (TZP,Ce), ceria stabilized tetragonal zirconia polycrystal }

M_r / (g mol^{-1}) = 123.223+172.115x	Temperature range / (°C) = -196 to 400	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a



$ZrO_2 \cdot xCeO_2$ (tetragonal) { zirconium dioxide, zirconia, Ce-TZP, ceria stabilized tetragonal zirconia polycrystal }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T °C	Density g/cm³	Vol.Frac. Porosity	Long. Velocity km/s	Shear Velocity km/s	Elastic Modulus GPa	Shear Modulus GPa	Bulk Modulus GPa	Poisson's Ratio	Ft. Nt.
189	Table	2	x	ult. pulse echo	1	23	6.22		6.71	3.45	195	73.9	180	0.319	1
189	Graph	1	x	flexural resonance	1	27	6.22				194				1
189	Graph	1	x	flexural resonance	1	78					193				1
189	Graph	1	x	flexural resonance	1	97					192				1
189	Graph	1	x	flexural resonance	1	148					191				1
189	Graph	1	x	flexural resonance	1	198					189				1
189	Graph	1	x	flexural resonance	1	223					187				1
189	Graph	1	x	flexural resonance	1	299					183				1
189	Graph	1	x	flexural resonance	1	401					178				1
189	Graph	1	x	flexural resonance	2	37	6.24				194				1
189	Graph	1	x	flexural resonance	2	88					193				1
189	Graph	1	x	flexural resonance	2	107					192				1
189	Graph	1	x	flexural resonance	2	158					191				1
189	Graph	1	x	flexural resonance	2	206					188				1
189	Graph	1	x	flexural resonance	2	230					188				1
189	Graph	1	x	flexural resonance	2	307					183				1
189	Graph	1	x	flexural resonance	2	411					179				1
190	Table	2	x	ultrasonic velocity		23	5.68				175				2
190	Table	2	x	ultrasonic velocity		23	6.00				179				2
190	Table	2	x	ultrasonic velocity		23	6.07				181				2
190	Table	2	x	ultrasonic velocity		23	6.01				176				2
190	Table	2	x	stress vs. strain		23	5.68				169				2
190	Table	2	x	stress vs. strain		23	6.00				180				2
190	Table	2	x	stress vs. strain		23	6.07				175				2
190	Table	2	x	stress vs. strain		23	6.01				175				2
191	Table	I	x	flexural resonance	1	27	5.774				122.8				3
191	Table	I	x	flexural resonance	1	-196					142.3				3
191	Table	I	x	flexural resonance	2	27	5.687				107.1				4
191	Table	I	x	flexural resonance	2	-196					130.3				4
191	Table	I	x	flexural resonance	3	27	5.687				115.7				5

$ZrO_2 \cdot xCeO_2$ (tetragonal) { zirconium dioxide, zirconia, Ce-TZP, ceria stabilized tetragonal zirconia polycrystal }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
191	Table	I	x	flexural resonance	3	-196					132.5				5

Footnotes:

1: Reported composition (mole fraction): 88 % ZrO_2 + 12 % CeO_2

2: Reported composition (mole fraction): 91 % ZrO_2 + 9 % CeO_2

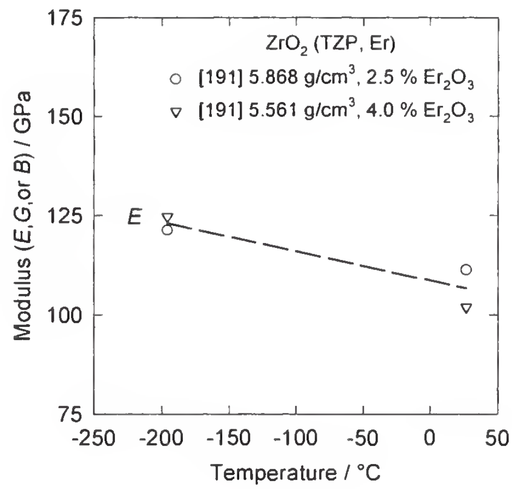
3: Reported composition (mole fraction): 85.5 % ZrO_2 + 14.5 % CeO_2

4: Reported composition (mole fraction): 84.5 % ZrO_2 + 15.5 % CeO_2

5: Reported composition (mole fraction): 83.5 % ZrO_2 + 16.5 % CeO_2

9.52 $ZrO_2 \cdot xEr_2O_3$ (tetragonal) { zirconium dioxide, zirconia, Er-ZrO_2 (TZP), ZrO_2 (TZP,Er), erbia stabilized tetragonal zirconia polycrystal }

M_r / (g mol^{-1}) = 123.223+382.516x	Temperature range / (°C) = -196 to 27	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = n/a	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a



$ZrO_2 \cdot xEr_2O_3$ (tetragonal) { zirconium dioxide, zirconia, Er-TZP, erbia stabilized tetragonal zirconia polycrystal }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
191	Table	I	x	flexural resonance	1	27	5.868				111.3				1
191	Table	I	x	flexural resonance	1	-196					121.3				1
191	Table	I	x	flexural resonance	2	27	5.561				101.9				2
191	Table	I	x	flexural resonance	2	-196					124.7				2

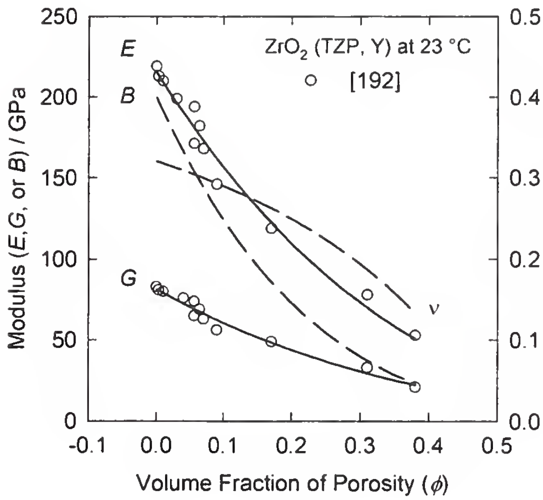
Footnotes:

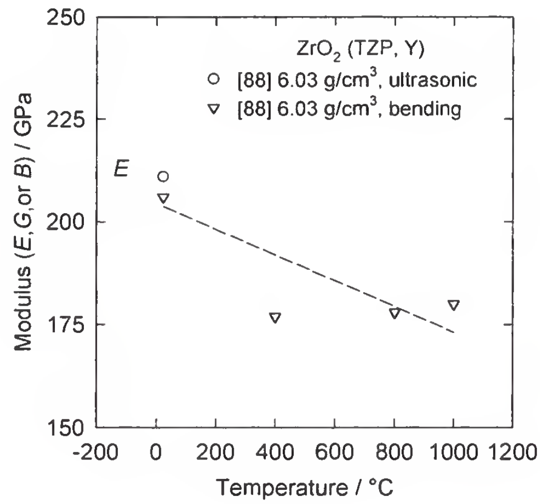
1: Reported composition (mole fraction): 97.5 % ZrO_2 + 2.5 % Er_2O_3

2: Reported composition (mole fraction): 96.0 % ZrO_2 + 4.0 % Er_2O_3

9.53 $ZrO_2 \cdot xY_2O_3$ (tetragonal) { zirconium dioxide, zirconia, Y-ZrO_2 (TZP), ZrO_2 (TZP,Y), yttria stabilized tetragonal zirconia polycrystal }

M_r / (g mol^{-1}) = 123.223+225.810x	Temperature range / (°C) = 23 to 1000	
ρ_{theo} / (g cm^{-3}) = n/a	Porosity range = 0 to 0.4	
	E_o / (GPa) = n/a	B_o / (GPa) = n/a
	a / (10^{-4}°C) = n/a	b / (10^{-4}°C) = n/a
	n = n/a	m = n/a





$ZrO_2 \cdot xY_2O_3$ (tetragonal) { zirconium dioxide, zirconia, Y-TZP, yttria stabilized tetragonal zirconia polycrystal }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm^3		km/s	km/s	GPa	GPa	GPa		
88	Table	P4	x	ultrasonic method		23	6.03				211	81		0.312	1
88	Graph	P8	x	bending		23	6.03				206				1
88	Graph	P8	x	bending		400					177				1
88	Graph	P8	x	bending		800					178				1
88	Graph	P8	x	bending		1000					180				1
192	Graph	2	x	ultrasonic velocity		23		0.000			219				2
192	Graph	2	x	ultrasonic velocity		23		0.003			213				2
192	Graph	2	x	ultrasonic velocity		23		0.010			210				2
192	Graph	2	x	ultrasonic velocity		23		0.030			199				2
192	Graph	2	x	ultrasonic velocity		23		0.056			194				2
192	Graph	2	x	ultrasonic velocity		23		0.056			171				2
192	Graph	2	x	ultrasonic velocity		23		0.064			182				2
192	Graph	2	x	ultrasonic velocity		23		0.070			168				2
192	Graph	2	x	ultrasonic velocity		23		0.090			146				2
192	Graph	2	x	ultrasonic velocity		23		0.170			119				2
192	Graph	2	x	ultrasonic velocity		23		0.310			78				2
192	Graph	2	x	ultrasonic velocity		23		0.380			53				2
192	Graph	2	x	ultrasonic velocity		23		0.000				83			2
192	Graph	2	x	ultrasonic velocity		23		0.003				81			2
192	Graph	2	x	ultrasonic velocity		23		0.010				80			2
192	Graph	2	x	ultrasonic velocity		23		0.040				76			2
192	Graph	2	x	ultrasonic velocity		23		0.056				74			2
192	Graph	2	x	ultrasonic velocity		23		0.056				65			2
192	Graph	2	x	ultrasonic velocity		23		0.064				69			2
192	Graph	2	x	ultrasonic velocity		23		0.070				63			2
192	Graph	2	x	ultrasonic velocity		23		0.090				56			2
192	Graph	2	x	ultrasonic velocity		23		0.170				49			2
192	Graph	2	x	ultrasonic velocity		23		0.310				33			2
192	Graph	2	x	ultrasonic velocity		23		0.380				21			2
192	Graph	2	x	ultrasonic velocity		23		0.000					200		2
192	Graph	2	x	ultrasonic velocity		23		0.003					195		2

$ZrO_2 \cdot xY_2O_3$ (tetragonal) { zirconium dioxide, zirconia, Y-TZP, yttria stabilized tetragonal zirconia polycrystal }

Ref. Nbr.	Exh. Type	Exh. Nbr.	Value Type	Method of Determination	Mtl. Nbr.	T	Density	Vol.Frac. Porosity	Long. Velocity	Shear Velocity	Elastic Modulus	Shear Modulus	Bulk Modulus	Poisson's Ratio	Ft. Nt.
						°C	g/cm³		km/s	km/s	GPa	GPa	GPa		
192	Graph	2	x	ultrasonic velocity		23		0.010					189		2
192	Graph	2	x	ultrasonic velocity		23		0.030					175		2
192	Graph	2	x	ultrasonic velocity		23		0.050					173		2
192	Graph	2	x	ultrasonic velocity		23		0.060					158		2
192	Graph	2	x	ultrasonic velocity		23		0.060					167		2
192	Graph	2	x	ultrasonic velocity		23		0.070					164		2
192	Graph	2	x	ultrasonic velocity		23		0.090					124		2
192	Graph	2	x	ultrasonic velocity		23		0.170					69		2
192	Graph	2	x	ultrasonic velocity		23		0.310					42		2
192	Graph	2	x	ultrasonic velocity		23		0.380					38		2

Footnotes:

1: Reported composition (mass fraction): 95 % ZrO_2 + 5 % Y_2O_3

2: Reported composition 3Y-TZP (mole fraction): 97 % ZrO_2 + 3 % Y_2O_3