NBSIR 87-3552

NDE Publications: 1984

Leonard Mordfin, Editor

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Institute for Materials Science and Engineering
Office of Nondestructive Evaluation
Gaithersburg, MD 20899

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U.S. DEPARTMENT OF COMMERCE
REAU OF STANDARDS

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U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

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1. Introduction

This is the eighth in a series of bibliographies of NBS publications on nondestructive evaluation (NDE). Previous reports in this series have been:

NBSIR 78-1557, "NDE Publications: 1972-1977"
NBSIR 80-2080, "NDE Publications: 1978",
NBSIR 81-2351, "NDE Publications: 1979",
NBSIR 81-2364, "NDE Publications: 1980",
NBSIR 83-2741, "NDE Publications: 1981",
NBSIR 85-3183, "NDE Publications: 1982", and
NBSIR 86-3396, "NDE Publications: 1983".

This report provides bibliographic citations for publications that appeared in the open literature during the calendar year 1984. Also included are citations for several publications that appeared in previous years but were not listed in the earlier compilations.

Almost all of these publications were authored by members of the NBS staff and include papers published in non-NBS media as well as papers and reports from the NBS publications series. A few were written for NBS by non-NBS authors. Many of the publications cited are based on research that was supported, in whole or in part, by the NBS Office of Nondestructive Evaluation.

These publications address a wide variety of NDE methods, both those that are well established in industry and some that are relatively new. For completeness, several publications dealing with technologies that are closely related to modern NDE, such as process monitoring and nondestructive materials characterization, have been included.

The format of this report is the same as that used previously. Brief, edited abstracts are provided for most of the publications cited. The bibliography and the abstracts comprise Section 2 of the report. The 103 entries of the bibliography are listed in alphabetical order by the surname of the first author.

Section 3 of the report is a subject index for the publications listed. This index is quite comprehensive and, when used together with the abstracts and the alphabetical bibliography, may be expected to enable readers to locate publications of interest without difficulty.

The last section of the report provides some assistance to readers wishing to obtain copies of specific publications listed.

2. Bibliography and Abstracts

1. Anon. Glossary of terms and definitions for acoustic emission testing procedures, Military Standard MIL-STD-1945, 8 p (24 October 1984).

2. Anon. Program and abstracts, ninth international symposium on ultrasonic imaging and tissue characterization, June 3-6, 1984, Washington, DC, Ultrasonic Imaging 6, No. 2, 201-241 (April 1984).

3. Anon. Safe design and use of panoramic, wet source storage gamma irradiators (category IV), American National Standard N43.10, NBS Handbook 142, 36 p (July 1984). Available from NTIS as PB84-242015. Available from Supt. of Docs. as SN003-003-02598-4.

   This standard applies to irradiators that contain sealed gamma emitting sources for the irradiation of objects or materials. It establishes the criteria to be used in the proper design, fabrication, installation, use, and maintenance of these irradiators which will ensure a high degree of radiation safety at all times.

4. Baylies, W. A.; Scace, R. I.; Vieweg-Gutberlet, F. International standards for semiconductor materials, ASTM Standardization News 11, No. 5, 21-23 (May 1983).

   Semiconductor silicon is an internationally traded commodity which requires sophisticated characterization procedures for producer's quality control and purchaser's incoming inspection tests. A technically consistent set of test methods is described.

5. Behrens, J. W.; Johnson, R. G.; Schrack, R. A. Neutron resonance transmission analysis of reactor fuel samples. Nuclear Technology 67, 162-168 (Oct 84).

   Neutron resonance transmission analysis (NRTA) was used to measure the isotopic content of fresh and spent nuclear reactor fuel samples. Using the National Bureau of Standards 100-MeV electron Linac as a pulsed neutron source, neutron transmission spectra were measured for two samples of fresh reactor fuel and two samples of spent fuel. For the fresh fuel samples, the contents were determined and compared to the results of a destructive analysis. Excellent agreement was obtained. For the spent fuel samples, the abundances of actinides and fission products were obtained. NRTA was shown to be a method for nondestructive analysis with high isotopic discrimination and high accuracy.

6. Bean, V. E.; Long, F. G. High pressure liquid level monitor, Patent 4,447,743, 12 p (8 May 1984). Available from Patent and Trademark Office, Arlington, VA 20231, $1.00.

   A liquid level monitor for tracking the level of a coal slurry in a high-pressure vessel including a toroidal-shaped float with magnetically permeable bands thereon disposed within the vessel, two pairs of magnetic field generators and detectors disposed outside the vessel and magnetically coupled to the bands on the float, and circuitry for combining signals from the detectors for generating a control signal

which is a function of liquid level. The signal may be utilized to operate valves associated with processes in which the vessel is used.

7. Belsher, D. R.; McLaughlin, R. H.; Repjar, A. G.; Bussey, H. E. Microwave detection of lost wells and unknown water-filled voids in coal mines. NBSIR-84-3017, 87 p. (Sep 1984). Available from NTIS as PB85-137669.

   The development of improved antennas useable with both a pulse system or an FM-CW system is described. The development of a field prototype pulse sampling system is described. Initial theoretical work on the problem of dielectric loading of antennas as well as a study of potential system range is included.

8. Berk, N. F. Theory of SANS from large particles and voids, NBS Reactor: Summary of Activities July 1982 through June 1983, NBS TN 1190, F.J. Shorten, ed., 106-107 (April 1984).

9. Berk, N.; Fravel, D; Glinka, C. J.; LaRock, J.; Rowe, J. M. Advanced neutron methods, NBS Reactor: Summary of Activities July 1982 through June 1983, NBS TN 1190, F.J. Shorten, ed., 79-81 (April 1984).

10. Berk, N. F.; Hardman-Rhyne, K.; Case, E. SANS investigations of porosity in yttrium chromate ceramics, NBS Reactor: Summary of Activities July 1982 through June 1983, NBS TN 1190, F.J. Shorten, ed., 85-86 (April 1984).

11. Birnbaum, G.; White, G. S. Laser techniques in NDE, Research Techniques in Nondestructive Testing 7, R. S. Sharpe, ed., 259-365 (Academic Press, 1984).

    Laser techniques in NDE are reviewed. These methods include optical reflection and scattering, laser-induced thermal and acoustic waves, and laser-induced electronic excitations in semiconductors. The theory of these methods, their experimental verification, and the NDE applications are discussed.

12. Blau, P. J. Investigation of the nature of micro-indentation hardness gradients below sliding contacts in five copper alloys worn against 52100 steel. Jnl. of Materials Science 19, 1957-1968 (1984).

    This paper presents the results of a study of the differences in the variation of micro-indentation hardness with depth below sliding contact surfaces. Metallography was performed using tapered cross-sections of the sliding surfaces of the Cu alloys. There was no obvious correlation between relative wear volumes of the alloys and the magnitude of their near surface micro-indentation hardness gradients.

13. Blessing, G. V.; Bagley, P. P.; James, J. E. Effect of surface roughness on ultrasonic echo amplitude in steel. Materials Evaluation 42, no. 11, 1389-1392, 1400 (October 1984).

The effect of surface roughness on the amplitude of ultrasonic echos has been studied for longitudinal waves in steel over a frequency range of 1 to 20 MHz. A set of five steel sample disks possessed (one side) front surface roughnesses of a periodic nature ranging from 1 to 23 micrometers rms in height. Successive back-surface echo amplitudes were measured for the water-immersed samples using a multi-cycle tone burst technique. In addition, front surface echos were monitored as a function of roughness at 10 MHz in water, and at 2.3 MHz in air. While at the lower frequencies, the surface roughnesses had little effect on echo amplitude, at 10 MHz and above the amplitude was observed to monotonically decrease with increasing roughness. For a given roughness value, diffraction effects dominated at the lower frequencies, while scattering and attentuation dominated at the higher frequencies.

14. Blessing, G. V.; Hsu, N. N.; Proctor, T. M. Ultrasonic shear wave measurements of known residual stress in aluminum. Experimental Mechanics 24, no. 3, 218-222 (September 1984).

Ultrasonic shear wave time-of-flight measurements were made at 4 MHz on a shrink-fit disk sample of aluminum alloy. The stress state of the sample was produced by shrink-fitting a plug and ring to produce a calculated 65 MPa region of uniform compression in the plug, and a concomitant non-uniform tension and compression in the ring. Scans across sample diameters were made using a piezoelectric shear transducer with a viscous couplant, and repeated using a contactless electromagnetic acoustic transducer. The ultrasonic results were compared with elasticity theory.

15. Blessing, G. V.; Hsu, N. N.; Proctor, T. M. Ultrasonic shear wave measurements of known residual stress in aluminum, Nondestructive Methods for Material Property Determination, C. O. Ruud and R. E. Green, Jr., eds., 353-363 (Plenum Press, New York, NY, 1984).

See Item No. 14.

16. Breckenridge, F. R.; Watanabe, T. Appendix [to "A new method of acoustic emission transducer calibration" by M. Ohtsu and K. Ono], J. Acoustic Emission 3, No. 2, 66-68 (April-June 1984).

The calibration curves for a surface-pulse and for a through-pulse for all the transducers have been obtained by Nippon Steel Co. (NSC) and by NBS. The results show that the through-pulse calibration curves are in good agreement between the NBS and NSC measurements. For a surface-pulse, a slight discrepancy between the results of NBS and NSC was observed.

17. Broadhurst, M. G.; Davis, G. T. Physical basis for piezoelectricity in PVDF, Ferroelectrics 60, 3-13, (1984).

The molecular and bulk structures of PVDF and related semicrystalline polymers are reviewed, and the effects of processing to make transducer films is discussed. A novel way of analyzing the elastic and piezoelectric constant data is introduced.

18. Brown, D. W.; Lowry, R. E.; Smith, L. E. Prediction of the long-term stability of polyester-based recording media, NBSIR 84-2988, 49 p. (December 1984).

Aging studies with poly[ethylene terephtalate] film base indicate the lifetime is equal to about 1000 years if the material is stored at 20-25°C and 50% relative humidity.

19. Burch, D. M.; Mathey, R. G.; Rossiter, W. J., Jr. Moisture and roof performance, ASTM Standardization News 12, No. 11, 26-28 (Nov. 1984).

Nondestructive methods have been developed to detect regions of the roof that contain moisture. Three methods are currently being used: infrared thermography, nuclear backscatter, and electrical capacitance. These methods detect changes in properties of the roofing system due to moisture and do not directly detect water. Thus, the reliability of the results depends upon factors such as instrument variability, effect of construction variables on instrument response, interpretation of instrument response, and knowledge of the roofing system and its components.

20. Carino, N. J. Laboratory study of flaw detection in concrete by the pulse-echo method, InSitu/Nondestructive Testing of Concrete ACI SP-82, V. M. Malhotra, ed., 557-579 (American Concrete Institute, 1984).

A study was performed to evaluate the applicability of using the echoes from mechanically produced impact to locate hidden defects within concrete. The expected interactions of spherical waves with concrete-air interfaces are reviewed, and the results of experiments using artificial flaws in a large concrete slab are summarized.

21. Carino, N. J.; Sansalone, M. Pulse-echo method for flaw detection in concrete, NBS TN-1199, 42 p. (July 1984). Available from NTIS as PB84-234509. Available from Supt. of Docs as SN003-003-02601-8.

The basic principles of the pulse-echo method for the detection of internal flaws in concrete are presented. As the heterogeneous nature of concrete poses problems not encountered in metals, progress in this area of concrete nondestructive testing has been slow. A review of past research shows that pulse-echo techniques have been used successfully to detect flaws within concrete; however, no standardized method currently exists for evaluation of concrete structures. Based on the current state of knowledge, areas of needed research are outlined.

22. Carpenter, B. S.; Greenberg, R. R. High accuracy determination of U-235 by gamma-ray spectroscopy in nondestructive assay standards, NBS Reactor: Summary of Activities July 1982 through June 1983, NBS TN 1190, F. J. Shorten, ed., 155-157 (April 1984).

23. Candela, G. A.; Chandler-Horowitz, D. An ellipsometry system for high accuracy metrology of thin films, Integrated Circuit Metrology II, Proc. SPIE 480, 2-8 (1984).

A computer-controlled spectroscopic ellipsometer of high accuracy has been designed and constructed. This instrument is primarily used for the metrology of semiconductor materials and for the calibration of reference standards for thin film thickness and refractive index.

24. Chandler-Horowitz, D.; Candela, G. A. On the accuracy of ellipsometric thickness determinations for very thin films, J. de Physique 44, C10-23 (December 1983).

25. Chang, Y.-M. L.; Grot, R. A. The role of thermography in the assessment of the thermal integrity of federal office buildings, An International Conference on Thermal Infrared Sensing for Diagnostics and Control (Thermosense VI) Proc. SPIE 446, G. J. Burrer, ed., 47-55 (SPIE, Bellingham, WA, 1984).

Results are presented from ground-based infrared thermographic studies on eight federal office buildings. Infrared thermography was utilized to observe the thermal anomalies in those buildings, as part of a diagnostic program to evaluate the thermal integrity of building envelopes. The potential applications of the diagnostic procedures to both new and existing buildings are discussed.

26. Charles River Associates, Technological and economic assessment of advanced ceramic materials, Vol. 1, Summary and conclusions, NBS GCR 84-470-1, 78 p. (August 1984). Available from NTIS as PB 85-113082.

Improved measurement and testing techniques as well as standard reference data and materials will have important impacts at all levels of activity in the advanced ceramics industry including R&D, processing and process control, improving and controlling final product properties and performance, and market development. The most important items are improved nondestructive evaluation technology and development of standard testing procedures. Closely related is the need for well-characterized, standardized reference materials.

27. Charles River Associates, Technological and economic assessment of advanced ceramic materials, Vol. 5, A case study of ceramic, toxic and combustible, gas sensors, NBS GCR 84-470-5, 67 p. (August 1984). Available from NTIS as PB85-113124.

Chapter 2 provides an overview of ceramic sensors. The third chapter provides a brief background discussion of ceramic gas sensor technology.

28. Clark, A. F.; Reed, R. P., eds., Advances in Cryogenic Engineering 30 (Materials), 1020 p. (Plenum Press, NY, 1984).

In Volume 30 you will find papers on composites and polymers. These include finite-element modeling of fiber-reinforced composites, accurate measurement of low-temperature physical and mechanical properties, and nondestructive inspection. Careful measurements on elastic properties, acoustic emission, thermal conductivity, and chemical effects from radiation are reported.

29. Clough, R. B.; Wadley, H. N. G.; Biancaniello, F. S. Acoustic emission studies of electron beam melting and rapid solidification, Nondestructive Evaluation: Application to Materials Processing, O. Buck and S. M. Wolf, eds., 27-40 (ASM, 1984).

Acoustic emission is well suited for monitoring electron beam induced melting and rapid solidification, providing a real time, volumetric survey of the processes. The present study examines the origin of acoustic emission during melting and rapid resolidification of Al and Al-4.5% Cu using heat flow theory and microstructure characterization. The electron beam, because of its relatively slow rise time, was found not to produce acoustic emission directly. The motion of the liquid-solid interface, for the same reason, also fails to generate detectable acoustic emission. Acoustic emissions were found to be generated by plastic deformation and sometimes crack growth.

30. Clough, R. B.; Wadley, H. N. G.; Mehrabian, R. Heat flow-acoustic emission-microstructure correlations in rapid surface solidification, Lasers in Materials Processing, E. A. Metzbower, ed., 37-46 (ASM, 1983).

Techniques are needed for in situ measurement of the dynamics of laser and electron beam material interactions, possibly leading to in-process control applications and the detection of defective conditions. Acoustic emission methods show promise for this. Acoustic emission accompanying absorption of electron beams have been measured from aluminum alloys. The emission appears, in these alloys, to be generated by sudden stress relaxations accompanying plastic deformations and hot tearing, both induced by solidification stresses.

31. Cohen, J. Thermal-imaging system performance measures for nondestructive testing, An International Conference on Thermal Infrared Sensing for Diagnostics and Control (Thermosense VI) Proc SPIE 446, G. J. Burrer, ed., 176-180 (SPIE, Bellingham, WA, 1984).

Thermal images result from temperature differences and/or emissivity differences (apparent temperature differences) in a scene or target. It is the function of a thermal-imaging system to reproduce an acceptable visible image of the scene or target from its thermal content. Thus, a thermal-imaging system is required to resolve spatial differences of temperature and emissivity. The performance of a thermal-imaging system may be specified by means of the fundamental performance measures, noise-equivalent temperature difference, minimum-resolvable temperature difference and/or minimum detectable temperature difference. The measurement and the significance of each of these performance measures is discussed.

32. Eitzen, D. G.; Wadley, H. N. G. Acoustic emission: establishing the fundamentals, Jnl of Research of the National Bureau of Standards 89, no. 1, 75-100 (Jan.-Feb. 1984). Available from NTIS as PB84-235530.

In the mid-1970s a program of fundamental research was initiated at NBS to improve the scientific understanding of acoustic emission. Many individual results of this research have been reported in the literature and are beginning to be incorporated in a new generation of acoustic emission instrumentation, in improved test methodologies, and in the analysis of data. Here, we summarize the problems faced by acoustic emission midway through the last decade, review the accomplishments of the NBS program and related research programs, and outline the research that will be required in future years.

33. Elkind, B. J., Ultrasonic characterization of microstructurally modified surfaces of steels subjected to electron-beam irradiation, Report CMR-NDE-15 (Johns Hopkins Univ., Baltimore, 1984).

34. Elkind, B. J.; Rosen, M.; Horowitz, E. Nondestructive characterization of electron-beam glazed plain carbon steels, Report CMR-NDE-13 (Johns Hopkins Univ., Baltimore, Feb. 1984).

35. Escalante, E.; Cohen, M.; Kahn, A. H. Measuring the corrosion rate of reinforcing steel in concrete, NBSIR 84-2853, 86 p. (April 1984). Available from NTIS as PB84-244532.

    A research program directed at developing a nondestructive method for measuring the corrosion of steel in concrete as related to bridge deck deterioration is reported.

36. Fang, J. B.; Grot, R. A. Heat loss due to thermal bridges in buildings, An International Conference on Thermal Infrared Sensing for Diagnostics and Control (Thermosense VI), Proc. SPIE 446, G. J. Burrer, ed., 34-42 (SPIE, Bellingham, WA, 1984).

    Infrared thermography was used to identify thermally defective areas resulting from inadequate construction, design, or substandard workmanship in existing buildings. Due to the large thermal inertia of building components and transient conditions caused by fluctuating tempertures, long measurement periods are required. This makes thermography impractical for quantifying the heat loss. In order to estimate the heat loss rate, a two-dimensional heat flow model has been developed. The calculated results from the model are compared with available experimental data. An in-situ measurement technique is described.

37. Fick, S. E.; Breckenridge, F. R.; Tschiegg, C. E.; Eitzen, D. G. Ultrasonic absolute power transfer standard, Jnl of Research of the National Bureau of Standards 89 no. 2, 209-212 (Mar.-Apr. 1984). Available from NTIS as PB85-115426. Available from Supt. of Docs as SN003-003-72086-1.

    In response to increased interest in the use of calibrated sources of ultrasonic energy, we have developed a system to facilitate the accurate transfer of calibration. Prototype transducers have shown good output at frequencies up to 78 MHz. Units now available to the public can be calibrated at output powers ranging from 5mW to 500 mW at frequencies between 1 and 20 MHz.

38. Fickett, F. R. Magnetic measurements, calibrations, and standards: report on a survey, NBSIR 84-3018, 25 p. (Oct. 1984). Available from NTIS as PB85-127827.

The report summarizes the analysis of responses to a survey of industrial needs for magnetic services and research.

39. Fortunko, C. M.; Schramm, R. E.; Moulder, J. C.; McColskey, J. D. Electromagnetic-acoustic-transducer/synthetic-aperture system for thick-weld inspection, NBS Technical Note 1075, 130 p. (May 1984). Available from NTIS as PB84-219492. Available from Supt. of Docs. as SN003-003-02578-0.

This report describes a system based on electromagnetic-acoustic transducers (EMATs) as an approach to automated nondestructive evaluation of thick weldments (≥25 mm). Good signal-to-noise ratios were possible through careful design and the use of signal averaging. At 454 kHz, the transducers produce shear-horizontal waves of approximately 7-mm wavelength in steel. The long wavelength permits determination of through-thickness flaw depth from the amplitudes of scattered ultrasonic waves. The synthetic aperture technique further improved signal quality and yielded flaw localization through the weld thickness. Measurements demonstrated a detectability threshold of 0.5 mm (through thickness) and sizing ability up to 2.5 mm, in agreement with theoretical predictions.

40. Friant, C. L.; Rosen, M.; Green, R. E., Jr.; Mehrabian, R. Ultrasonic NDE of rapidly solidified products and its application to process control, Nondestructive Evaluation: Application to Materials Processing, O. Buck and S. M. Wolf, eds., 51-59 (ASM, 1984).

The properties and morphology of rapidly solidified alloys are very sensitive to variations in process parameters. Hence, nondestructive evaluation during or after manufacture is necessary to provide feedback for process control. Ultrasonic techniques are attractive for process control because the volume of material inspected in a single rapid test can be large enough to give an accurate indication of aggregate properties. Guided longitudinal and shear waves were used in the present study to determine the elastic properties of rapidly solidified alloys in ribbon and sheet geometries.

41. Fuller, E. R., Jr.; Fields, R. J.; Chuang, T. J.; Singhal, S. Characterization of creep damage in metals using small angle neutron scattering. Jnl of Research of the National Bureau of Standards 89, no. 1, 35-45 (Jan.-Feb. 1984).

Creep damage in polycrystalline metallic materials can be attributed to cavitation and cracking along the grain interfaces. Theories of creep cavitation that have been developed in recent years are reviewed. Small angle neutron scattering studies provide one experimental tool which is suitable for studying nucleation and early growth of creep cavities.

42. Gevarter, W. B. An overview of artificial intelligence and robotics, Volume I - Artificial intelligence, Part A - The core ingredients, NBSIR 83-2799, 74 p. (Feb. 1984).

The goal of Artificial Intelligence is focused on developing computational approaches to intelligent behavior. This report endeavors to clarify what AI is, the foundations on which it rests, the techniques utilized, applications, the participants and, finally, AI's state-of-the-art and future trends.

43. Greenspan, M. Book review [of "Ultrasonics" by P. D. Edmonds, ed., Methods of Experimental Physics 19], J. Acoust. Soc. Am. 75, No. 4, 1310 (April 1984).

44. Grot, R. A.; Chang, Y.-M. The evaluation of infrared imaging systems used for building inspections, An International Conference on Thermal Infrared Sensing for Diagnostics and Control (Thermosense VI), Proc. SPIE 446, G. J. Burrer, ed., 247-252 (SPIE, Bellingham, WA, 1984).

The results of the laboratory evaluation of three high resolution infrared imaging systems are presented. The systems were evaluated for their minimum resolvable temperature difference (MRTD) at spatial frequencies from 0.02 to 0.16 cycles per milliradian and at ambient temperatures in the range of -7° C to 20° C. The results are compared with the predicted dependence of the MRTD given in ASHRAE Standard 101-83. It is shown that the dependence on temperatures of two of the systems is predicted by the theory given in the standard. The calibration curves of the infrared imaging systems are in good agreement with those given by the manufacturers.

45. Hardman-Rhyne, K.; Berk, N. F.; Case, E. D. Porosity study of sintered and green compacts of yttrium chromate using small angle neutron scattering techniques, Nondestructive Evaluation: Application to Materials Processing, O. Buck and S. M. Wolf, eds., 103-108 (ASM, 1984).

Sintered and "green" compact samples of yttrium chromate are studied to determine the void sizes and density using small angle neutron scattering techniques which have been extended to the beam broadening regime to detect sizes larger than 0.15 micrometers. This approach can be used with other on-line monitoring techniques, such as ultrasonics, to standardize their results. Although the density ratio of the voids in the "green" compact and sintered material are very different, the average void radius is very similar.

46. Hardman-Rhyne, K.; Berk, N. F.; Fuller, E. R. Jr. Microstructural characterization of ceramic materials by small angle neutron scattering techniques, Jnl. of Research of the National Bureau of Standards 89, no. 1, 17-34 (Jan.-Feb. 1984). Available from NTIS as PB84-235530.

The use of small angle neutron scattering (SANS) techniques for ceramic materials is discussed. Two areas are emphasized: (1) diffraction for microstructural phenomena of less than 100 nm, and (2) beam broadening for microstructural phenomena greater than 90 nm.

47. Hsu, N. N.; Eitzen, D. G. Analytical approach to acoustic emission signal processing: problems and progress, Proc 7th International Acoustic Emission Symposium, M. Onoe, K. Yamaguchi and H. Takahashi, eds., 326-334 (Japanese Society for Non-Destructive Inspection, 1984).

48. Hust, J. G.; Lankford, A. B. Update of thermal conductivity and electrical resistivity of electrolytic iron, tungsten, and stainless steel, NBS/SP-260/90, 75 p. (Sep. 1984). Available from NTIS as PB85-115814. Available from Supt. of Docs as SN003-003-02609-3.

New data are presented and, based on these, changes in the recommended values are described.

49. Jesch, R. L.; McLaughlin, R. H. Dielectric measurements of oil shale as functions of temperature and frequency, Institute of Electrical and Electronics Engineers Transactions on Geoscience and Remote Sensing GE -22, no. 2, 99-105 (March 1984).

50. Johnson, E. G. Jr. Using optical processing to find the beam profile of a laser pulse (theory), Optical Radiation Measurements, Proc. SPIE 499, 75-88 (1984).

51. Kahn, A. H. Impedance of a coil in the vicinity of a crack, Review of Progress in Quantitative Nondestructive Evaluation 3A, 579-587 (1984).

In the design of electromagnetic NDE systems for the detection and examination of cracks and other defects in conducting materials, it is desirable to have a quantitative description of the fields in the vicinity of the defect. In previous work by this author and co-workers, the fields in the vicinity of a crack were calculated for models based on excitation by a spatially uniform applied field, as in the interior of a solenoid. The present work reports on an improved model which includes non-uniformity of the field of the exciting coil and the effects of coil size and position relative to the crack.

52. Kahn, A. H. Impedance of a coil in the vicinity of a crack, Jnl. of Research of the National Bureau of Standards 89, no. 1, 47-54 (Jan.-Feb. 1984). Available from NTIS as PB84-235530.

Calculations are presented for the impedance of a coil as it is moved in the vicinity of a v-groove crack in the surface of a metallic slab. The solutions are valid for arbitrary ratio of crack or coil dimensions to skin depth. A plot of the complex impedance is given in the form of a coil scan across the crack.

53. Kanda, M. An electromagnetic near-field sensor for simultaneous electric and magnetic-field measurements, IEEE Trans. Electromagn. Compat. EMC-26, No. 3, 102-110 (August 1984).

This paper describes the theory of a single sensor to perform simultaneous electric and magnetic near-field measurements. The theory indicates that it is possible to measure the magnetic-loop and electric-dipole currents using a loop antenna terminated with identical loads at two diametrically opposite points. The theory also indicates that it is possible to choose an ideal load impedance for achieving equal electric and magnetic-field responses of the loop. Preliminary experiments using a plane-wave field verify these results.

54. Kasen, M. B.; Hicho, G. E. Inherent through-wall depth limitations on blunt discontinuities in welds, Welding Jnl. 63, no. 6, 1845 - 1865 (June 1984).

This study examines the extent to which the through-wall depth of porosity and slag can be inferred from projected radiographic dimensions, and the validity of assuming that maximum depth is limited by the welding process. It is concluded that the through-wall depth of both types of flaws will not exceed that of the average weld pass depth in a multipass weld.

55. Kim, S.; Weertman, J. R.; Spooner, S.; Glinka, C. J.; Sikka, V.; Jones, W. B. Microstructural evaluation of a ferritic stainless steel by small angle neutron scattering, Nondestructive Evaluation: Application to Materials Processing, O. Buck and S. M. Wolf, eds., 169-176 (ASM, 1984).

A study is under way to evaluate the feasibility of using small angle neutron scattering (SANS) to detect microstructural changes which result from high temperature service and are likely to be associated with a degradation in strength. The major changes detected by the neutrons are alterations in size, number and composition of the carbides. Microstructural changes can be detected after only a few hours of fatigue. High voltage electron microscopy studies have shown that the major microstructural changes produced by high temperature exposure are carbide coarsening, subgrain development, and a drastic decrease in dislocation density.

56. King, R. B.; Fortunko, C. M. Residual-stress measurements using shear-horizontal waves from electromagnetic acoustic transducers. NBSIR-84-3002, 59 p. (March 1984). Available from NTIS as PB84-190636.

This collection of technical papers covers a two-year effort on a novel approach to measuring residual stresses using changes in ultrasonic wave velocities of horizontally polarized shear waves produced by electromagnetic-acoustic transducers. The initial three papers deal with the theoretical developments pointing to the measurement of in-plane residual stress as well as preliminary experimental verification. The later two papers generalize this theory and extend it to include surface residual stress measurement in an arbitrary plane; again, empirical validation is included.

57. King, R. B.; Fortunko, C. M. Surface-residual stress evaluation using horizontally polarized shear waves, Jnl of Applied Physics 55, no. 11, 3978-3983 (June 1, 1984).

A new theory and experimental method are described for evaluation of surface residual stresses in inhomogeneous, anisotropic materials. The method is based on the use of horizontally polarized shear waves (SH-waves) that propagate at a grazing angle with respect to the surface of a sample. In addition, a new theory is presented for grazing SH-waves propagating through a body in which the stress distribution varies with depth. It is shown that, to first order, the average velocity of the grazing SH-waves is dependent only on the surface values of residual stress. Preliminary experimental verification of the theory is presented.

58. Kowalski, P.; Lankford, W. F.; Schafft, H. A. Nondestructive measurement of solar cell sheet resistance using a laser scanner, IEEE Transactions on Electron Devices ED-31, no. 5, 566-570 (May 1984).

Experimental data have shown that a laser scanner can be used as a probe to make nondestructive measurements of solar cell sheet resistance with an accuracy of several percent. The photovoltaic response from cells with controlled sheet resistance was measured using the scanner and compared with the theoretical predictions made by other workers.

59. Kupperman, D. S.; Karplus, H. B.; Poeppel, R. B.; Ellingson, W. A.; Berger, H.; Robbins, C.; Fuller, E. Application of NDE methods to green ceramics: initial results, Nondestructive Evaluation: Application to Materials Processing, O. Buck and S. M. Wolf, eds., 89-101 (ASM, 1984).

This paper describes a preliminary investigation to assess the effectiveness of nondestructive evaluation of green (unfired) ceramics. The objective is to obtain useful information on defects, cracking, delaminations, agglomerates, inclusions, regions of high porosity, and anisotropy. The application of microradiography to ceramics is reviewed, and preliminary experiments are described. Conventional ultrasonic techniques are difficult to apply in green ceramics because of the high attenuation, fragility, and couplant-absorbing properties of these materials. However, velocity, attenuation, and spectral data were obtained with pressure-coupled transducers, and provided useful information related to density variations and the presence of agglomerates. Nuclear magnetic resonance (NMR) imaging techniques and neutron radiography were considered. With NMR, areas of high porosity might be detected after the samples are doped with water. In the case of neutron radiography, regions of high binder concentration (and thus high porosity) should be detectable, although imaging the binder distribution throughout the sample may not be feasible because of the low overall concentration of the binder.

60. Lawn, B. R.; Freiman, S. W.; Baker, T. L.; Cobb, D. D.; Gonzalez, A. C. Study of microstructural effects in the strength of alumina using controlled flaws, Jnl. of American Ceramic Society 67, no. 4, C-67-C-69 (April 1984).

A study is made of strength characteristics as a function of Vickers indentation load for two grain-size aluminas. At low loads the strengths tend to well-defined plateaus, the levels of which bear an inverse relationship with grain size. These trends are consistent with a transition from indentation-controlled to microstructure-controlled behavior as flaw size diminishes. The conventional indentation fracture formalism is modified to account for this transition.

61. Ledbetter, H. M.; Datta, S. K. Young's modulus and internal friction of SiC-particle-reinforced aluminum composite, Materials Science and Engineering 67, 25-30 (1984).

Using dynamic methods, the authors measured Young's modulus and the associated internal friction of a particle-reinforced composite in wrought plate form produced by powder metallurgy methods.

62. Ledbetter, H. M.; Datta, S. K.; Kriz, R. D. Elastic constants of an anisotropic, nonhomogenous particle-reinforced composite, Acta Metallurgica 32, No. 12, 2225-2231 (Dec. 1984).

We studied the elastic constants of a particle-reinforced-composite wrought plate produced by powder-metallurgy methods. By measuring ultrasonic-wave velocities using a pulse-echo method, we determined the complete nine-component elastic-constant tensor. Thermal-mechanical processing introduced orthotropic macroscopic elastic symmetry into the material. The elastic stiffnesses show large negative departures from a rule-of-mixture. Using wave-scattering methods and ensemble averaging, we develop a theory that predicts all the observed physical property phenomena.

63. Lettieri, T. R.; Jenkins, W. D. A review of ultrahigh resolution sizing of single droplets by resonance light scattering, Liquid Particle Size Measurement Techniques, ASTM STP 848, J. M. Tishkoff, R. D. Ingebo and J. B. Kennedy, eds., 99-108 (ASTM, 1984).

Resonance light scattering as a means for ultrahigh resolution sizing of liquid droplets in the 5 to 50 micrometer diameter range is reviewed. So far, the technique has been used to make relative size measurements with resolutions of 30 ppm on individual, non-evaporating droplets.

64. Linzer, M., ed. Ultrasonic Imaging 6, Nos. 1,2,3,4 (Academic Press, New York, N.Y., Jan., Apr., July, Oct. 1984).

This journal provides for original papers concerned with the development and application of ultrasonic techniques, with emphasis on medical diagnosis. Papers deal with theoretical and experimental aspects of advanced methods and instrumentation for imaging, computerized tomography, Doppler measurements, signal processing, pattern recognition, microscopy, and measurements of ultrasonic parameters.

65. Mopsik, F. I. Precision time-domain dielectric spectrometer. Review of Scientific Instruments 55, no. 1, 79-87 (Jan. 1984).

A description is given for an automated method for determining dielectric constant and loss by the measurement of the time response of the dielectric to a step voltage. In addition, a numerical Laplace Transform is described that preserves the accuracy of the time data when they are transformed into the frequency domain.

66. Mordfin, L. Ultrasonic weld inspection for nuclear power plant structures, Materials Evaluation 42, No. 1, 30-31 (Jan. 1984).

Book review of "Advances in Non-Destructive Examination in Relation to Structural Integrity," R. W. Nichols, editor, 447 p., Applied Science Publishers, London, 1982.

67. Mordfin, L., ed., Technical Activities 1983, Office of Nondestructive Evaluation. NBSIR-84-2815, 203 p. (Jan. 1984). Available from NTIS as PB84-217074.

A review of the Nondestructive Evaluation Program at NBS, for FY 1983, is presented in this annual report.

68. Mordfin, L., ed., Office of Nondestructive Evaluation: Technical Activities 1984, NBSIR 84-2944, 163 p. (Nov. 1984).

A review of the Nondestructive Evaluation Program at NBS, for FY 1984, is presented in this annual report.

69. Mordfin, L.; Yolken, H. T. Nondestructive testing and quality improvement, Non-Destructive Testing Australia 21, No. 2, 10-12, 19 (Australian Institute for Non-Destructive Testing, March/April 1984).

Efforts to improve the quality of manufactured products and, at the same time, to achieve increased productivity, are nurturing changes in the role of nondestructive testing. It is evident that it is no longer adequate to use NDT merely to separate good parts from bad at the end of the manufacturing process. Instead, process controls are needed which will prevent the manufacture of defective products. A new role for NDT in the development of manufacturing process controls is proposed.

70. Mountain, R. D.; Birnbaum, G. Scattering of sound waves by inhomogeneities: time domain analysis, Nondestructive Testing Communications 1, 219-225 (1984).

The scattering of sound waves by isolated inhomogeneities in an otherwise uniform solid is analyzed using the Born approximation in the time domain. The volume and shape of the scatterer are related to time moments of the amplitude of the scattered signal. The matching of the incident pulse shape to the size of the scatterer is found to be essential if this type of measurement is to yield useful results.

71. Nguyen, T. Nondestructive evaluations of steel corrosion under protective coatings using thermal-wave imaging, Proc. 33rd Defense Conf. on Nondestructive Testing, 155-164 (U.S. Army Armament, Munitions and Chemical Command, Dover, NJ, Nov. 1984).

This paper briefly reviews the technique of thermal-wave imaging and presents preliminary results on the applications of this method to imaging the corrosion of steel protected by organic coatings. The results show that thermal-wave imaging is capable of detecting and assessing early corrosion of steel under clear and opaque coatings.

72. Norton, S. J.; Testardi, L. R.; Wadley, H. N. G. Reconstructing internal temperature distributions from ultrasonic time-of-flight tomography and dimensional resonance measurements, Jnl. of Research of the National Bureau of Standards 89, no. 1, 65-74 (Jan.-Feb. 1984). Available from NTIS as PB84-235530.

Two ultrasonic techniques for reconstructing the internal temperature distribution in metal bodies--time-of-flight tomography and dimensional resonance profiling--are described. An analysis of the tomographic reconstruction of temperature (including ray refraction effects) in a cylindrical body is presented together with initial experimental results. Dimensional resonance profiling is a new technique that allows the reconstruction of a one-dimensional distribution of temperature in a structure from measurements of its resonant frequencies. While tomography is well suited for measuring temperature in a cylindrical geometry, a combination of dimensional resonance and tomography is the best method for rectangular slab geometry.

73. Nyyssonen, D. National Bureau of Standards, a review of NBS's activities in the area of linewidth measurement, Proc. Scientific Apparatus Makers Association Conf., The Future of Optical Technologies in the Semiconductor Industry, 1-7 (March 1984).

This is a summary of current NBS activities in linewidth measurement including research, calibration of standard reference materials (SRMs), development of calibration procedures and test methods, and technology transfer. The status of photomask linewidth SRMs is discussed. Wafer linewidth measurements are divided into two categories, thin layers and thick layers. The design of the linewidth standard for thin layers is described. Research problems remaining for thick layers are described along with current NBS waveguide modeling. Instrumentation used for both photomask and wafer calibrations is also described.

74. Nyyyssonen, D., ed. Integrated Circuit Metrology II, Proc. SPIE 480 (1984).

Characterization of lithographic systems continues to be an area of major importance although the emphasis has shifted to optical methods as opposed to electrical methods. With the emergence of submicron lithography scanning, electron microscope metrology has become an important part of IC fabrication. Optical inspection and critical dimension measurements continue to play a key role in process control and important new developments in instrumentation such as interferometry and fluorescence microscopy are apparent.

75. Nyyssonen, D. Optical linewidth measurement on patterned metal layers, Integrated Circuit Metrology II, Proc. SPIE 480, 65-70 (1984).

This paper allows the modeling of optical imaging and linewidth measurement on metal-on-silicon (MOS) structures. It is shown that the image structure for metals at and near focus is different from that for dielectrics. Thick and thin layer imaging are compared. Experimental image profiles of metal lines at and near focus are also shown. The experimental data were obtained from a bright-field microscope using a laser source and controlled spatial coherence.

76. Parker, R. L. Ultrasonic measurement of solid/liquid interface position during solidification and melting of iron and steel, Nondestructive Evaluation: Application to Materials Processing, O. Buck and S. M. Wolf, eds., 23-25 (ASM, 1984).

The solidification and melting of iron and stainless steel have been studied using a pulse-echo ultrasonic flaw detector. It has been possible to follow both melting and freezing by varying the position of the heating coil and photographing the corresponding motion of the echo on the oscilloscope. Some of the causes of the relatively weak echo and the high beam attenuation are described, along with experiments to improve signal/noise in this system. The aim, in part, is to provide a reliable, real-time, in-situ and nondestructive measurement of skin thickness in the continuous casting of steel, to help prevent breakouts.

77. Payne, B. F. Calibration of vibration pickups at high frequencies, Proc. 12th Transducer Workshop, 505-515 (Range Commanders Council, White Sands Missile Range, New Mexico, 1984).

Optical interferometric measurement methods can be used over a wide frequency range for accelerometer characterization. By using carefully designed shakers, amplitude measurements have been made over the frequency range of 3 to 29 kHz. Care should be exercised in the use of these methods at extended frequencies, to be certain that the shaker has uniaxial, undistorted motion over the frequency range of interest.

78. Potzick, J. E.; Robertson, B. Long wavelength acoustic flowmeter, Patent 4,445,389, 19 p. (1 May 1984). Available from Patent and Trademark Office, Arlington, VA 20231, $1.00.

An acoustic flowmeter is described for measuring the flow of an arbitrary single-phase fluid in a pipe. Sound waves are induced in the fluid at two frequencies, one twice the other. The phases and amplitudes of the waves are detected by two microphones located in the wall of the pipe, one downstream from the other a distance of six diameters or more. The frequencies of the sound are automatically adjusted so that the shorter wavelength is equal to the distance between microphones. The instrument then measures in real time the volume flow rate of, and the sound speed in, the fluid, independent of fluid composition or temperature.

79. Prask, H. J.; Choi, C. S. Nondestructive characterization of sub-surface residual stress, NBS Reactor: Summary of Activities July 1982 through June 1983, F. J. Shorten, ed., NBS TN 1190, 31-34 (April 1984).

80. Prask, H. J.; Choi, C. S. The nondestructive determination of near-surface residual stresses in depleted uranium alloys, Proc. 33rd Defense Conf. on Nondestructive Testing, 177-185 (U.S. Army Armament, Munitions & Chemical Command, Dover, NJ, Nov. 1984).

Last year we presented a description of a technique, energy dispersive neutron diffraction (EDND), by which subsurface residual stresses could be measured nondestructively in textured materials--including depleted uranium alloys (DU). In our recent work we have extended the EDND technique for near-surface residual stress measurement. We have nondestructively measured hoop stresses in the outer millimeter of 24-mm diameter DU production samples for the first time.

81. Proctor, T. M.; Breckenridge, F. R.; Eitzen, D. G. The development of high fidelity acoustic emission transducers, Proc. 6th International Conf. on NDE in the Nuclear Industry, H. Wadley, ed., 329-337 (ASM, Metals Park, OH, 1984).

The development of a transducer which measures the normal displacement of a "point" on a surface is reviewed. This transducer can measure, with high sensitivity, the dynamic surface motion due to an AE event. Captured waveforms are compared with theoretical elasticity predictions of surface displacement. The transducer will be made available for purchase as a transfer standard through the SRM Program of NBS. Preliminary results from a new transducer for measuring tangential surface motion are also presented.

82. Sauder, W. C. An ultrasonic determination of the gas constant, Precision Measurement and Fundamental Constants II, B. N. Taylor and W. D. Phillips, eds., NBS SP 617, 277-279 (1984).

Progress on a gas constant determination by means of ultrasonic interferometry is reported. The acoustic interferometer is a two arm instrument designed to operate in the range 0.1-1.0 MHz. Electrostatic transducers have been designed for the experiment that will allow characterization of the acoustic field, a necessary step in extracting wave length measurements from the fringe data.

83. Schrack, R. A. Microchannel plate neutron detector. Nuclear Instruments and Methods in Physics Research 222, 499-506 (1984).

A two-dimensional, position-sensitive neutron detector using a microchannel plate electron multiplier with resistive anode has been developed for use in resonance neutron radiography. The resolution characteristics of the detector are determined for different scintillator arrangements. The use of the detector is demonstrated in producing separated images of three elements in a complex matrix sample.

84. Schramm, R. E.; Fortunko, C. M.; Moulder, J. C. Advanced methods for noncontact inspection of welds using electromagnetic-acoustic transducers. Review of Progress in Quantitative Nondestructive Evaluation 3B, 1425-1432 (1984).

The authors describe an improved EMAT configuration for use in an automated inspection system for butt weldments. A minicomputer controls transducer positioning, data acquisition, and digital signal processing to improve flaw detection, sizing, and localization. In particular, good detectability is possible with a synthetic aperture method that combines ultrasonic data from several transducer locations to produce a focusing effect and increase the signal-to-noise-ratio.

85. Schramm, R. E.; Moulder, J. C.; Fortunko, C. M. Nondestructive evaluation of thick austenitic stainless steel weldments by shear horizontal acoustic waves. Advances in Cryogenic Engineering 30, 119-126 (1984).

Austenitic stainless steel weldments exhibit a textured columnar structure. Because of this, shear horizontal acoustic waves can be a valuable complement to conventional longitudinal waves. Developments in electromagnetic acoustic transducers have made it possible to use these SH-waves. Digital processing techniques, particularly synthetic aperture techniques, can improve the detection, sizing and localization of flaws.

86. **Shorten, F. J., ed. NBS reactor: summary of activities July 1982 through June 1983, NBS TN 1190, 206 pp (April 1984). Available from NTIS as PB84-179282. Available from Supt. of Docs. as SN003-003-02566-6.**

This report summarizes programs which depend on the NBS reactor. The programs range from the use of neutron beams to study the structure and dynamics of materials to neutron radiography and nondestructive evaluation.

87. **Simmons, J. A.; Wadley, H. N. G. Vector transducer calibration, Review of Progress in Quantitative Nondestructive Evaluation 3B, 699-706 (Plenum, 1984).**

A receiving ultrasonic or acoustic emission transducer converts a vector property of an elastic wave (particle displacement, velocity or acceleration) to a scalar voltage. Recent theoretical advances have enabled prediction of these vector quantities and attempts are underway to make measurements that can be compared with theory. An essential step in this process is the calibration of transducers; not just for spectral sensitivity, but for their absolute vector response. A simple scheme for determining the vector calibration of a transducer is derived from the properties of the Green's tensor of an isotropic elastic body.

88. **Simmons, J. A.; Wadley, H. N. G. Theory of acoustic emission from phase transformations, Jnl of Research of the National Bureau of Standards 89, no. 1, 55-64 (January - February 1984). Available from NTIS as PB84-235 530.**

A theoretical framework is developed within which it is possible to predict the dynamic elastic displacement field (acoustic emission) for a phase transformation in which there is a change of both crystal structure (elastic constants) and shape (density). An integral equation is presented for the acoustic emission displacement field due to formation of inhomogeneous inclusions. Expressions for the source of elastic radiation are explicitly calculated for small isotropic spherical and ellipsoidal inclusions embedded in an isotropic matrix. These expressions are used for qualitative interpretation of recent experiments on martensitic transformations in steels.

89. **Simmons, J. A.; Wadley, H. N. G. Theory of acoustic emission from inhomogeneous inclusions, Wave Propagation in Homogeneous Media and Ultrasonic Nondestructive Evaluation, AMD Vol. 62, 51-60 (ASME, 1984).**

See item no. 88.

90. Singhal, S. P.; Mozer, B.; Fields, R. J. Small angle neutron scattering (SANS) study of creep damage in 304 stainless steel, NBS Reactor: Summary of Activities July 1982 through June 1983, NBS TN 1190, F. J. Shorten, ed., 87-95 (April 1984).

91. Smith, J. J. Nondestructive characterization of rapidly solidified aluminum-magnesium alloys, Report CMR-NDE-14, 48 p. (Johns Hopkins University, Baltimore, 1984).

92. Smith, J. J.; Rosen, M.; Wadley, H. N. G. Nondestructive characterization of rapidly solidified Al-Mn alloys by ultrasonic and electrical methods, Nondestructive Evaluation: Application to Materials Processing, O. Buck and S. M. Wolf, eds., 61-69 (ASM, 1984).

The effect of supersaturation induced by rapid solidification on the ultrasonic velocity and electrical resistivity of aluminum-manganese alloys has been measured. The ultrasonic technique employed a laser to generate ultrasonic pulses that were subsequently detected by a piezo-electric transducer placed a known distance from the pulse. Young's moduli were calculated from the ultrasonic wave velocity and x-ray density measurements. Both ultrasonic velocity and electrical resistivity measurements were shown to be suitable nondestructive evaluation techniques for on-line process monitoring of melt spun products.

93. Takagi, S.; Chow, L. C.; Brown, W. E.; Dobbyn, R. C.; Kuriyama, M. Parallel beam microradiography of dental hard tissue using synchrotron radiation and x-ray image magnification, Nuclear Instruments and Methods in Physics Research 222, 256-258 (1984).

A novel technique utilizing a highly parallel beam of monochromatic synchrotron radiation combined with x-ray image magnification has been used to obtain microradiographs of caries lesions in relatively thick tooth sections.

94. Vorburger, T. V.; Teague, E. C.; Scire, F. E.; McLay, M. J.; Gilsinn, D. E., Surface roughness studies with DALLAS--detector array for laser light angular scattering, Jnl of Research of the National Bureau of Standards 89, no. 1, 3-16 (January - February 1984). Available from NTIS as PB84-235530.

An instrument has been developed to study surface roughness by measuring the angular distributions of scattered light. In our instrument, a beam from a laser illuminates the surface at an angle of incidence which may be varied. The scattered light distribution is detected by an array of fiber optic sensors positioned in a semicircular yoke which can be rotated about its axis so that the scattered radiation may be sampled over an entire hemisphere.

95. Wadley, H., ed., Proc. 6th International Conference on NDE in the Nuclear Industry (ASM, Metals Park, OH, 1984).

96. Wadley, H. N. G.; Mehrabian, R. Acoustic emission for in-process monitoring and microstructure control? Nondestructive Methods for Material Property Determination, C. O. Ruud and R. E. Green, Jr., eds., 207-236 (Plenum Press, New York, NY, 1984).

In this review we describe the theoretical framework that has begun to emerge and which now provides a physical understanding of acoustic emission. We then assess, in the light of this understanding, the contribution acoustic emission methods might make toward in-process monitoring and microstructure control during metals processing.

97. Wadley, H. N. G.; Norton, S. J.; Biancaniello, F. S.; Mehrabian, R. Ultrasonic measurement of internal temperature distribution, Nondestructive Evaluation: Application to Materials Processing, O. Buck and S. M. Wolf, eds., 3-11 (ASM, 1984).

We report studies directed toward the development of a sensor system for the measurement of internal temperature distribution in hot metals. The technique is based upon the observation that in metals the velocity of elastic waves decreases with increase in temperature. The measurement of ultrasonic velocity along a ray propagating through a metal body gives the average temperature along the ray. Computer simulations are used to show that the temperature profile can be deduced from a set of velocities propagating along different ray paths. Experimental results are presented for stainless steel.

98. Wadley, H. N. G.; Simmons, J. A.; Turner, C. Predictive modeling of quantitative acoustic emission waveforms, Review of Progress in Quantitative Nondestructive Evaluation 3B, 683-697 (Plenum, 1984).

The general elastodynamic theory for acoustic emission from defect sources is reviewed. A multipolar approximation is used to predict the epicenter waveforms for two models of cracking and thermoelastic generation by a laser pulse. This approach may provide a basis for a new quantitative method of thermal wave microscopy.

99. Yee, K. W. Use of drill-up for on-line determination of drill wear, Society of Manufacturing Engineers Technical Paper MS84-914 (1984).

Drill-Up is an instrument for determining drill wear and predicting drill breakage by applying time-domain analysis to a signal from an accelerometer coupled to the workpiece.

100. Yee, K. W.; Blomquist, D. S. Rotating tool wear monitoring apparatus, Patent 4,471,444, 9 p (11 September 1984). Available from Patent and Trademark Office, Arlington, VA 20231, $1.00.

A system is provided for predicting when the failure of a rotating machine tool or part is imminent or when a tool is worn. The system includes a transducer for producing an output related to the workpiece vibrations caused by the machine tool and an analog comparator which compares this output with the normal operation.

101. Yen, D.; Linholm, L. W. Using linewidth measurement test structures to evaluate lithographic processes and equipment, Test & Measurement World 4, No. 3, 48-61 (March 1984).

102. Yin, L. I.; Bielefeld, M. J.; Seltzer, S. M.; Trombka, J. I. Tomographic and 3-D simulations using NORA (non-overlapping redundant array). Applied Optics 23, no. 14, 2239-2241 (July 15, 1984).

It is possible to use NORA to reconstruct and view extended x-ray objects with low photon statistics in 3-D, using spherical lenses, as well as to obtain complete tomographic information free of out-of-focus artifacts. Analog 3-D viewing may prove invaluable in the interpretation of tomographic reconstructions.

103. Young, M. Can you describe optical surface quality with one or two numbers, Proc. SPIE 406, 12-22 (1984).

This talk discusses two optical surface quality standards, total integrated scatter (TIS) and the scratch and dig standard (MIL-0-13830A). The standard should perhaps be regarded as a scattered light standard and not as a surface roughness standard.

3. Subject Index

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