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NDE PUBLICATIONS: 1980

Leonard Mordin, Editor

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
National Measurement Laboratory
Office of Nondestructive Evaluation
Washington, DC 20234

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1. Introduction

This is the fourth 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"; and NBSIR 81-2351, "NDE Publications: 1979". This report provides bibliographic citations for publications that appeared in the literature during calendar year 1980. Also included are citations for several publications that appeared in previous years but were not listed in the earlier compilations.

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. Many of the publications cited are based on research that was supported, in whole or in part, by the NBS Office of Nondestructive Evaluation. The 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 directly support NDE, such as imaging and piezoelectricity, 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 108 entries in 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., Program and abstracts, Fifth International Symposium on Ultrasonic Imaging and Tissue Characterization and Second International Symposium on Ultrasonic Materials Characterization, June 1-6, 1980, National Bureau of Standards, Gaithersburg, MD, 148 pages (1980).

2. Anon., Calibration of acoustic emission sensors, EPRI Journal 5, No. 8, 52-54 (Electric Power Research Institute, Palo Alto, CA, Oct. 1980).

3. Anon., NBS scientist inspects jet engines, NBS Standard 25, No. 24, p. 3 (Nov. 26, 1980).

In a cooperative program with the U.S. Navy and Teledyne CAE, NBS physicist Donald Garrett has used neutron radiography to quickly check for safe oil levels within compact jet engines used in missile systems.

4. Baum, M., In the pursuit of precision, Dimensions/NBS 64, No. 1, 13-15 (Jan./Feb. 1980).

NBS has awarded two Precision Measurement Grants for research which will lead to improved values of several fundamental physical constants. One of the grants went to Professor W. Sauder of the Virginia Military Institute for the development of a new type of ultrasonic interferometer.

5. Baum, M., The sounds of failure, Dimensions/NBS 64, No. 4, 12-18 (May/June 1980).

A review of the NBS interdisciplinary research program on acoustic emission NDE.

6. Behrens, J. W., Johnson, R. G., Bowman, C. D., Pinhole camera imaging of neutrons using a position-sensitive proportional counter, Trans. Am. Nucl. Soc. 34, 663-664 (1980).

We describe progress in imaging eV neutrons produced by a spatially extended source using a position-sensitive proportional counter in a pinhole camera configuration. This work is being conducted (1) for a better understanding of the eV neutron source characterization from the neutron-producing target at the NBS linac, (2) for the development of resonance neutron radiography, and (3) for possible use in imaging high energy neutron sources.

7. Behrens, J. W., Schrack, R. A., Carlson, A. D. and Bowman, C. D., Resonance neutron radiography for nondestructive evaluation and assay applications, Nuclear Cross Sections for Technology, J. C. Fowler and C. H. Johnson, Eds., NBS Spec. Publ. 594, 436-439 (Sept. 1980).

8. Behrens, J. W., Schrack, R. A., Bowman, C. D., Nondestructive examination of a defective silver braze using resonance-neutron radiography, Nucl. Technol. 51, No. 1, 78-82 (Nov. 1980).

Resonance-neutron radiography is being developed at the National Bureau of Standards (NBS) for use in nondestructive evaluation (NDE) and assay (NDA) applications. To illustrate the method we determined the distribution and thickness of silver between two silver-brazed metal plates.

9. Berger, H., Nondestructive testing of railroad rail, Transportation Res. Record 744, 22-26 (1980).

Techniques of nondestructive testing of railroad rail in service are reviewed with the aim of assessing the state of the art and future needs. The contributions to the industry of the primary NDT methods--ultrasonic and magnetic inspection--are noted, and their limitations are examined. Recommendations for improving rail NDT include greater use of these two complementary systems, greater attention to operator training and characteristics and to the inspection of new rail before installation, and changes in government regulations that will lead to more effective use of rail test cars.

10. Berger, H., Birnbaum, G. and Free, G., Recent progress in eddy current testing, Proc. Int. Symp. New Methods of Non-Destructive Testing of Materials and their Application Especially in Nuclear Engineering, Saarbrucken, West Germany, Sept. 17-19, 1979, pp. 99-106 (Deutsche Gesellschaft für Zerstörungsfreie Prüfung, Berlin, West Germany, Mar. 1980).

The effectiveness of eddy current nondestructive testing is being enhanced by recent advances in theoretical analysis, new measurement methods, and the use of automation and computers for data analysis, as evidenced by

papers presented at a Symposium held September 1979 in USA. This paper presents a survey of the symposium papers dealing with multifrequency techniques, automation methods and data analysis including pattern recognition.

11. Berger, H., Lapinski, N. P. and Reimann, K. J., Neutron laminagraphy for inspection of nuclear fuel subassemblies, Proc. Int. Symp. New Methods of Non-Destructive Testing of Materials and Their Application Especially in Nuclear Engineering, Saarbrucken, West Germany, Sept. 17-19, p. 275-282 (Deutsche Gesellschaft für Zerstörungsfreie Prufung, Berlin, West Germany, Mar. 1980).

Multiple-film laminagraphy to display individual object planes within a complex, reactor fuel subassembly is described. Neutron radiography methods in the thermal, resonance and fast energy ranges are shown to be capable of good laminagraphic results.

12. Berger, H. and Mordfin, L., Eds., Annual report 1979, Office of Nondestructive Evaluation NBSIR 80-2007, 91 pages (March 1980).

This is the second in the series of annual reports on the NBS program in nondestructive evaluation. These reports summarize the program's activities and plans. The focus of the present report is on the program's activities in Fiscal Year 1979.

13. Berger, H., Nondestructive testing in the 80's, Met. Prog. 118, No. 3, 33-37 (Aug. 1980).

Increased use is seen for computer technology and signal processing, for the nondestructive characterization of both defects and material parameters, for traceable NDT measurements and continuous monitoring of machinery, engines and structures.

14. Berger, H. and Linzer, M., Eds., Ultrasonic materials characterization, (Proceedings of the First International Symposium on Ultrasonic Materials Characterization held at the National Bureau of Standards, Gaithersburg, MD, June 7-9, 1978), Nat. Bur. Stand. (U.S.), Spec. Publ. 596, 644 pages (Nov. 1980) SN003-003-02264-1, $11.00.

The use of ultrasonic nondestructive testing to characterize materials both in terms of properties and flaws is the subject of this volume.

15. Berger, H., Calibration for NDE measurements, Dimensions/NBS 64, No. 9, inside cover (Nov. 1980).

16. Berger, H., Testing without destruction, Dimensions/NBS 64, No. 9, 6-9 (Nov. 1980).

A summary of common NDE techniques; calibrations and standards for NDE; and some NDE-related standard reference materials.

17. Berger, H. and Mordfin, L., Eds., Technical activities 1980--Office of Nondestructive Evaluation, NBSIR 80-2162, 119 pages (Nov. 1980). Order from NTIS as PB81-132466, $11.00.

A review of nondestructive evaluation programs at NBS for FY1980 is presented in this annual report.

18. Bertocci, U., Electrochemical noise measurements: a new measurement technique for diagnosis and study of localized corrosion, National Measurement Laboratory - 1979 Technical Highlights, NBS Spec. Publ. 572, 92-94 (April 1980) SN003-003-02203-7, $4.25.

Fluctuations in the electron potential and/or current of corroding electrodes are giving information on the breakdown and repair of protective films and are being studied as a possible means of detecting the output of localized corrosion.

19. Blau, P. J., Use of a two-diagonal measurement method for reducing scatter in Knoop microhardness testing, Scr. Metall. 14, 719-724 (1980).

The two-diagonal method may be most useful where only a limited sample of material is available and large numbers of microhardness tests cannot easily be performed.

20. Boettinger, W. J., Burdette, H. E. and Kuriyama, M., Energy dispersive xrf composition profiling using crystal collimated incident radiation, Advances in X-Ray Analysis 23, J. R. Rhodes, et al, Eds., 209-217 (1980).

21. Bowman, C. D., Efficient neutron production using low-energy electron beams, Nucl. Sci. Eng. 75, 12-15 (1980).

Neutron production with an electron beam can be as energy efficient with 10-MeV electrons as with the conventionally used 30- to 100-MeV electrons.

22. Broadhurst, M. G. and Davis, G. T., Piezoelectricity and pyroelectricity in poly (vinylidene fluoride), National Measurement Laboratory - 1979 Technical Highlights, NBS Spec. Publ. 572, 89-92 (April 1980) SN003-003-02203-7, $4.25.

We present a general description of the molecular structure of PVDF, show how a simple piezoelectric model was developed and successfully tested, and describe the important consequences of this development.

23. Broadhurst, M. G., Edelman, S. and Davis, G. T., Piezoelectric and pyroelectric applications of plastics, Organic Coatings and Plastics Chemistry 42, 241-245 (American Chemical Society, Washington, DC, 1980).

Synthetic polymeric materials can have large and durable electric dipole polarization. This polarization varies linearly with small applied stresses such as electric fields, mechanical stress and temperature change, and this sensitivity renders them useful as piezoelectric and pyroelectric transducers. That is, they can be used to provide an analog electrical signal to monitor mechanical and thermal signals, and inversely, can provide mechanical motion and changes in heat content in response to applied electric fields.

24. Bullis, W. M., Ed., Semiconductor technology program progress briefs, NBSIR 79-1591-5, 1979 December, 16 p. Order from NTIS as PB 81-154122, $5.00.

This report provides information on the current status of NBS work on measurement technology for semiconductor materials, process control, and devices. Highlighted activities include analysis of model spreading resistance data, and gross leak testing.

25. Bullis, W. M., Ed., Semiconductor technology program progress briefs, NBSIR 80-2006, 16 pages (Apr. 1980). Order from NTIS as PB 80-191521, $5.00.

Highlighted activities include: analysis of spreading resistance measurements, infrared detector materials, and gross leak testing.

26. Bullis, W. M., Ed., Semiconductor technology program progress briefs, NBSIR 80-2006-3, 1980 October, 12 p. Order from NTIS as PB 81-154106, $5.00.

Highlighted activities include optical linewidth and thermal resistance measurements.

27. Bullis, W. M., Ed., Semiconductor technology program progress briefs, NBSIR 80-2006-4, 1980 December, 12 p. Order from NTIS as PB 81-158602, $5.00.

Highlighted activities include spreading resistance measurements on gallium arsenide, and the time dependence of acoustic emission from seal cracks. Brief descriptions of the newly announced optical microscope linewidth measurement standard and a random fault test structure are given.

28. Canada, T. R. and Carpenter, B. S., Eds., Measurement technology for safeguards and materials control, Nat. Bur. Stand. (U.S.), Spec. Publ. 582, 769 pages (June 1980) SN003-003-02207-1, $11.00.

This publication contains the proceedings of the American Nuclear Society's Topical Conference entitled, Measurement Technology for Safeguards and Materials Control. The presentations were applications oriented and included nondestructive assay techniques, inspection techniques, and integrated systems for materials measurements.

29. Cheng, Y.-T. and Garrett, D. A., Nuclear safeguard interrogation of waste containers with resonant neutrons, Paper Summaries, 1980 ASNT Fall Conference, 97-99 (American Society for Nondestructive Testing, Columbus, OH, Oct. 1980).

A nuclear waste container is to be examined by a pencil neutron beam, the NBS double fission ionization chamber will be used to detect the transmitted neutrons, and through the self-indication effect the isotopic content in the waste will be identified.

30. Cook, K. V., Adler, L., Nanstad, R. K. and Golan, S., Measurement of fatigue crack profile in steel using an ultrasonic diffraction technique, Paper Summaries, 1980 ASNT Spring Conference, 142-148 (American Society for Nondestructive Testing, Columbus, OH, March 1980).

The optimum angle for obtaining maximum amplitude from the diffracted waves was verified by theoretical and experimental results. Both pulse-echo and pitch-catch techniques were used.

31. Datta, S. K. and Ledbetter, H. M., Anisotropic elastic constants of a fiber-reinforced boron-aluminum composite, Mechanics of Nondestructive Testing, W. W. Stinchcomb, Ed., pp. 215-230 (Plenum, NY, 1980).

Elastic constants were measured and calculated for a laminated, uniaxially fiber-reinforced boron-aluminum composite. Measurements were by ultrasonic velocity and resonance methods. The random-distribution model agrees best with observation, especially for off-diagonal elastic constants. Considering all nine elastic constants, observation and theory differ on the average by six percent.

32. Duffy, M. T., Zanzucchi, P. J., Ham, W. E., Corboy, J. F. and Cullen, G. W., Semiconductor measurement technology: Method to determine the quality of sapphire, Nat. Bur. Stand. (U.S.) Spec. Publ. 400-62, 74 pages (Aug. 1980) SN003-003-02222-5, $4.00.

Specular reflectance measurements were used in the quantitative characterization of sapphire and silicon surfaces. This measurement is sensitive to crystalline quality, polishing damage, and surface texture which

cause light-scattering effects. The reflectance methods are fast, non-destructive, and can be used for quality control and research purposes.

33. Eitzen, D. G., Berger, H. and Birnbaum, G., A basis for traceable NDE standards, Proc. DARPA/AFML Review of Progress in Quantitative Nondestructive Evaluation, D. O. Thompson and R. B. Thompson, Eds., Report AFWAL-TR-80-4078, 586-589 (Air Force Wright Aeronautical Laboratories, Dayton, OH, July 1980).

NBS is beginning to provide a mechanism for traceability for a number of NDE measurement procedures, an activity that is expected to have a significant, positive impact on the reproducibility and accuracy of NDE measurements. Much of the activity has been in ultrasonics and acoustic emission, leading to calibration services for ultrasonic reference blocks and ultrasonic and acoustic emission transducers. Additional NDE standards are available or are being developed in radiography, eddy currents, magnetic particles, liquid penetrants and visual testing.

34. Eitzen, D. G., Berger, H. and Birnbaum, G., A basis for traceable NDE measurements, NBSIR 80-2109, 17 pages (Dec. 1980). Order from NTIS as PB 81-145757, $5.00.

See abstract for No. 33.

35. Ellingson, W. A., Berger, H., Three-dimensional radiographic imaging, Research Techniques in Nondestructive Testing IV, R. S. Sharpe, Ed., 1-38 (Academic Press Inc., London, England, 1980).

The various three-dimensional imaging methods will be described, with selected examples of NDT applications; also, the limitations of the more developed methods with respect to in-plane and plane-to-plane resolution will be pointed out.

36. Escalante, E., Ito, S. and Cohen, M., Measuring the rate of corrosion of reinforcing steel in concrete, NBSIR 80-2012, 44 pages (Mar. 1980). Order from NTIS as PB 80-170848, $6.00.

The progress toward a nondestructive method for measuring the corrosion of steel in concrete is reported. Several polarization techniques for measuring the corrosion rate of steel in concrete are correlated to actual weight loss measured gravimetrically. The design of a prototype automated minicomputer system for measuring the corrosion of steel in concrete is also described. Included are the results of a study on corrosion in motar.

37. Feldman, A., Waxler, R. M., Properties of crystalline materials for optics, SPIE J. 204, 68-76 (1980).

A tutorial review of refractive index, absorption, birefringence, the electro-optic effect and the photoelastic effect in crystalline materials is presented.

38. Feldman, A., Ed., Basic optical properties of materials--Summaries of papers, Nat. Bur. Stand. (U.S.), Spec. Publ. 574, 252 pages (May 1980) SN003-003-02173-3, $6.50.

This Special Publication contains summaries of papers presented at the Topical Conference on Basic Optical Properties of Materials held in Gaithersburg, Maryland, on May 5-7, 1980. The principal topical areas are: Nonlinear Optical Properties; Ultraviolet Properties; Infrared Properties; Graded Index Materials; Inhomogeneous Materials; Properties of Thin Films; Optical Fibers, Planar Optical Waveguides; External Influences--Piezo-optics, Thermo-optics, Magneto-optics.

39. Feldman, A. and White, G., Optical nondestructive evaluation, Dimensions/ NBS 64, No. 9, p. 22 (Nov. 1980).

NBS researchers have been performing both measurements and model calculations of radiation scattered from well-defined shallow grooves in metallic surfaces.

40. Fields, B. F., Eddy current imaging system, Dimensions/NBS 64, No. 1, p. 18 (Jan./Feb. 1980).

41. Fiori, C. E. and Newbury, D. E., Artifacts in energy dispersive x-ray spectrometry in the scanning electron microscope (II), Scanning Electron Microscopy, pp. 251-258 (SEM Inc., Chicago, IL, 1980).

42. Fong, J. T., Inservice data reporting standards for engineering reliability and risk analysis, Nuclear Engineering and Design 60, 159-161 (North Holland Publishing Co., 1980).

The notion of an adequate data base is defined in terms of three essential elements. It is then demonstrated that an 'optimal' plan of

data reporting and some national or international standards for such reporting are desirable. A formula for estimating variabilities based on a combination of inservice and failure data is proposed.

43. Fong, J. T., Dobbyn, R. C. and Mordfin, L., Eds., Critical materials and fabrication issues for pressure vessels, piping, pumps, and valves, Nat. Bur. Stand. (U.S.), Spec. Publ. 588, 112 pages (June 1980) SN003-003-02215-2, $4.25.

Through an intensive series of meetings, presentations, and reviews, twelve issues on the materials and fabrication aspects of technical problems in the pressure vessels and piping industry were identified. The issues include: On-line monitoring of critical components to improve reliability; Upgrading welders' skill and educational level; Reliability of nondestructive evaluation; Characterization of the subjective component of inservice data. This report contains extended abstracts of the twelve issue papers and summaries of reviewers' comments.

44. Garrett, D. A. and Bracher, D. A., Eds., Real-time radiologic imaging: medical and industrial applications, ASTM Spec. Tech. Publ. 716, 352 pp. (Oct. 1980).

Twenty-two papers cover the state of the art for both industrial and medical applications of real-time radiologic imaging methods. Topics include fundamentals, detectors, standards and limits of image formation, special applications, and computer-based systems.

45. Garrett, D. A. and Stinebring, R. C., The use of x-ray and neutron radiography to evaluate lithium/iodine pacemaker batteries, Paper Summaries, 1980 ASNT Fall Conference, 215-219 (American Society for Nondestructive Testing, Columbus, OH, Oct. 1980).

NBS has used neutron radiography for studying internal changes in lithium/iodine batteries during accelerated discharge. Neutron radiographs were compared with x-ray radiographs and the results indicate that the two techniques are complementary to each other.

46. Glinka, C. J., Prask, H. J. and Choi, C. S., Neutron diffraction and small-angle scattering as nondestructive probes of the microstructure of materials, Mechanics of Nondestructive Testing, W. W. Stinchcomb, Ed., pp. 143-164 (Plenum Publ. Corp., New York, NY, 1980).

This article gives a brief introduction to small-angle and wide-angle neutron scattering methods as they pertain to the nondestructive evaluation of materials properties. Examples are presented which illustrate the techniques discussed.

47. Golan, S., Adler, L., Cook, K. V., Nanstad, R. K. and Bolland, T. K., Ultrasonic diffraction technique for characterization of fatigue cracks, J. Nondestr. Eval. 1, No. 1, 11-19 (1980).

This paper describes an ultrasonic diffraction technique for characterizing fatigue cracks. The angular field of energy scattered from a crack tip was computed. Using the theoretically predicted and experimentally verified optimum range of angles, we measured the crack profiles by the ultrasonic diffraction technique. Ultrasonic measurements agreed very

well with direct destructive measurements. In addition, fatigue crack closure was detected and information on crack surfaces was obtained.

48. Golan, S., Defect characterization and dimensioning of cracks in welds by the ultrasonic diffraction method, NBSIR 80-1983, 26 pages (Mar. 1980). Order from NTIS as PB 80-161755, $6.00.

The possibility of applying an ultrasonic diffraction method for dimensioning of crack-like defects in welds was investigated. A feasibility study was carried out and optimum test conditions were established using a series of welded specimens with in-weld cracks.

49. Golan, S., Sizing of cracks with scattered ultrasonic waves, Ultrasonic Materials Characterization, H. Berger and M. Linzer, Eds., NBS Spec. Publ. 596, 29-36 (Nov. 1980) SN003-003-02264-1, $11.00.

A method is described for calculating crack size from the time interval between the arrival of a surface compression reference beam and a beam scattered from the tip of the crack. Optimum measuring conditions have been determined. Good agreement between direct and ultrasonic measurements has been found.

50. Green, R. E., Jr., Ultrasonic measurement of residual stress, Ultrasonic Materials Characterization, H. Berger and M. Linzer, Eds., NBS Spec. Publ. 596, 173-177 (Nov. 1980) SN003-003-02264-1, $11.00.

General definitions of the various types of residual stresses are presented as well as a discussion of acoustoelasticity. A brief historical review of theoretical and experimental considerations for ultrasonic residual stress measurements follows. Finally, several problems and areas where additional research may be fruitful are pointed out.

51. Harman, G. G., The use of acoustic emission to determine the integrity of large hybrid packages, NBSIR 80-2055, 41 pp. (June 1980). Order from NTIS.

The specific objectives included: development of an acoustic emission detector sensitive to surface waves, but insensitive to vibration-induced cable noise; development of a high-temperature open-package helium leak test to observe marginal seal damage; and development of an acoustic emission test for inspection of hybrid packages during high-temperature thermal shock.

52. Higgins, F. P., Norton, S. J. and Linzer, M., Optical interferometric visualization and computerized reconstruction of ultrasonic fields, J. Acoust. Soc. Am. 68, No. 4, 1169-1176 (Oct. 1980).

A unique scanning Michelson interferometric system has been implemented for accurate measurement of the complex components of ultrasonic fields over wide apertures. Amplitude and phase information from transducers and scattering objects was acquired over planes using both narrowband and wideband insonification. Ultrasonic wavefronts at other planes and reconstruction of the test objects were computed by means of a fast Fourier transform technique.

53. Hsu, N. N. and Eitzen, D. G., Acoustic emission source characterization through direct time-domain deconvolution, Proc. DARPA/AFML Review of Progress in Quantitative Nondestructive Evaluation, D. O. Thompson and R. B. Thompson, Eds., Report AFWAL-TR-80-4078, 81-84 (Air Force Wright Aeronautical Laboratories, Dayton, OH, July 1980).

While acoustic emission signals contain potentially useful information about the deformation source mechanisms of a structure under load, signal processing techniques often fail to extract such information unambiguously. The difficulty lies both in the inherent complexity of the deformation mechanism and in the lack of understanding of the source mechanism, the wave propagation details, and the physics of the sensor's mechanical-to-electrical conversion process.

54. Jerke, J. M., Ed., Semiconductor measurement technology: Accurate linewidth measurements on integrated-circuit photomasks, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-43, 166 pages (Feb. 1980) SN003-003-02151-2, $5.00.

The progress of the NBS program to develop improved theory for accurate linewidth measurements with optical microscopes, to develop primary linewidth calibration on integrated-circuit photomasks, and to provide calibrated measurement artifacts and measurement procedures to industry is discussed. This report covers the initial period from September 1974 through December 1976.

55. Kahn, A. H. and Spal, R., AC magnetic fields in the vicinity of a crack calculated by analytic and numerical methods, Proc. DARPA/AFML Review of Progress in Quantitative Nondestructive Evaluation, D. O. Thompson and R. B. Thompson, Eds., Report AFWAL-TR-80-4078, 65-68 (Air Force Wright Aeronautical Laboratories, Dayton, OH, July 1980).

We report calculations of the impedance of a long solenoid which surrounds a cylinder of conducting material containing a radial surface crack. The calculation is accomplished by two independent methods. The results are displayed in graphical form giving the fractional changes of the real and imaginary parts of the complex impedance induced by the presence of the crack.

56. Kasdan, H. L., Linewidth measurement by diffraction pattern analysis, NBS-GCR-79-175, 159 pages (Apr. 1980). Order from NTIS as PB 80-199342, $11.00.

57. Kasen, M. B., Mikesell, R. P., Interim report on the significance of blunt flaws in pipeline girth welds, Proc. Int. Conf. on Pipeline and Energy Plant Piping, Calgary, Alberta, Canada, Nov. 10-13, 1980, 329-336 (1980).

Experiments are being performed to determine if slag, porosity or arc strikes are significant contributors to brittle fracture of pipeline girth welds. Flaw significance is being assessed by determining the number of cycles to crack initiation.

58. Kreider, K. G. and Sheahen, T. P., Use of infrared thermography for industrial heat balance calculations, Nat. Bur. Stand. (U.S.), Tech. Note 1129, 38 pages (July 1980) SN003-003-02216-1, $2.75.

59. Kruger, J., Bertocci, U., Escalante, E. and Mullen, J. L., Development of in-situ techniques for the detection and measurements of corrosion of copper concentric neutrals in underground environments, NBSIR 80-2083, 136 pages (June 1980). Order from NTIS as PB 81-101800, $10.00.

This is a final report which collects all of the papers written for the project.

60. Kuriyama, M., Boettinger, W. J. and Burdette, H. E., X-ray residual stress evaluation by an energy dispersive system, Accuracy in Powder Diffraction, S. Block and C. R. Hubbard, Eds., NBS Spec. Publ. 567, pp. 479-487 (Feb. 1980) SN003-003-02153-9, $9.00.

The energy of x-ray photons can be extended to considerably higher values, permitting better penetration into materials. Improved quality control of industrial components demands quantitative information concerning the stress distribution near cracks, and residual stress distributions after cold working. These demands lead to the necessity of measuring residual strains in the interior of materials. With a little extra precaution on the divergence of an incoming x-ray beam and the opening of the detector window, energy dispersive systems will respond to these demands. Furthermore, the curve fitting of each diffraction peak will provide sufficient precision for the determination of strains in materials. The use

of these systems makes it possible to determine the strain tensor in predetermined volumes in the interior of materials.

61. Kuriyama, M., Boettinger, W. J. and Burdette, H. E., Improved uses of x-rays for nondestructive evaluation, National Measurement Laboratory - 1979 Technical Highlights, NBS Spec. Publ. 572, 110-112 (April 1980) SN003-003-02203-7, $4.25.

The report is in two parts: x-ray image magnification; and x-ray residual stress evaluation in the interior of materials.

62. Kuriyama, M., Boettinger, W. J. and Burdette, H. E., Basic limits in real-time industrial radiographic systems, Real-Time Radiologic Imaging: Medical and Industrial Applications, D. A. Garrett and D. A. Bracher, Eds., ASTM Spec. Tech. Publ. 716, 113-127 (Oct. 1980).

In this paper, we discuss (1) collimation of primary radiation, including apparent size of sources, (2) monochromatic radiography to obtain true signals, (3) resolution improvement by a magnification of X-ray images before the radiation reaches the detecting (or viewing) system and, briefly, (4) intensification of signals when crystal collimation is used.

63. Larrabee, R. D. and Blackburn, D. L., Theory and application of a nondestructive photovoltaic technique for the meaurement of resistivity variations in circular semiconductor slices, Solid State Electron. 23, No. 10, 1059-1068 (1980).

64. Ledbetter, H. M., Dynamic elastic modulus and internal friction in fibrous composites, Nonmetallic Materials and Composites at Low Temperatures, A. F. Clark, R. P. Reed, G. Hartwig, Eds., pp. 267-281 (Plenum, NY, 1979).

65. Ledbetter, H. M., Dynamic elastic modulus and internal friction in G-10CR and G-11CR fiberglass-cloth-epoxy composites, Materials Studies for Magnetic Fusion Energy Applications at Low Temperatures - II, F. R. Fickett and R. P. Reed, Eds., NBSIR 79-1609, pp. 437-451 (June 1979). Order from NTIS as PB299288, $24.00.

66. Ledbetter, H. M., Frederick, N. V. and Austin, M. W., Elastic-constant variability in stainless-steel 304, J. Appl. Phys. 51, No. 1, 305-309 (Jan. 1980).

Variability of elastic constants in stainless-steel 304 was determined by measuring longitudinal and transverse ultrasonic velocities in 20 samples acquired randomly. Because of suprisingly small variations, 1% or less, the principal problem became measurement sensitivity and reproducibility. To overcome this problem, a high-resolution measurement system was devised using general-purpose equipment augmented with a simple impedance-transforming amplifier and an FET transmission gate. With this system the often-reported troublesome transit-time correction disappeared.

67. Ledbetter, H. M., Anomalous low-temperature elastic-constant behavior in Fe-13Cr-19Mn, Metall. Trans. 11A, 543-544 (Mar. 1980).

68. Ledbetter, H. M., Room-temperature elastic constants and low-temperature sound velocities for six nitrogen-alloyed austenitic stainless steels, Metall. Trans. A 11A, No. 6, 1067-1069 (June 1980).

Despite large composition differences, ultrasonic-velocity measurements in six nitrogen-strengthened stainless steels show that their elastic constants differ only slightly except as affected by low-temperature magnetic transitions.

69. Ledbetter, H. M., Sound velocities and elastic-constant averaging for polycrystalline copper, J. Phys. D: Appl. Phys. 13, 1879-1884 (1980).

This study deals with the relationship between single-crystal and polycrystalline elastic constants. For polycrystalline copper, sound velocities were measured within a 0.1% inaccuracy at T = 295 K. Comparison with average values from twelve previous studies shows agreement within 0.2%. Among eight elastic-constant averaging methods, the Hershey-Kröner-Eshelby method works best for copper. This averaging method predicts that copper's polycrystalline and single-crystalline Debye temperatures differ by about 9 K.

70. Lew, H. S., Fattal, S. G. and Hunt, B. J., Recommended guidelines for safety inspection of construction of concrete ccoling towers, NBSIR 80-1964, s6 pages (Feb. 1980). Order from NTIS as PB 80-170525, $6.00.

As a result of the tower construction disaster at Willow Island, West Virginia, the National Bureau of Standards developed guidelines for safety evaluation of reinforced concrete shell cooling tower construction. The guidelines highlight needed compliance inspection procedures. Major regulatory provisions affecting inspections are summarized.

71. Linzer, M., Ed., Ultrasonic imaging 2, Nos. 1, 2, 3, 4 (Academic Press, NY, Jan., April, July, Oct. 1980).

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.

72. Loftus, T. P., Standardization of Iridium-192 gamma-ray sources in terms of exposure, J. Res. Nat. Bur. Stand. (U.S.), 85, No. 1, 19-25 (Jan.-Feb. 1980).

73. MacDonald, D. E., On determining stress in bolts ultrasonically, Proc. DARPA/AFML Review of Progress in Quantitative Nondestructive Evaluation, D. O. Thompson and R. B. Thompson, Eds., Report AFWAL-TR-80-4078, 576-580 (Air Force Wright Aeronautical Laboratories, Dayton, OH, July 1980).

Several factors affecting the ultrasonic determination of stress in bolts are examined, in order to help clarify existing problems with the interpretation of certain experiments.

74. Mavrodineanu, R. and Baldwin, J. R., Standard reference materials: Metal-on-quartz filters as a standard reference material for spectrophotometry--SRM 2031, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-68, 116 pages (Apr. 1980) SN003-003-02167-9, $4.25.

75. McKinney, J. E., Davis, G. T. and Broadhurst, M. G., Plasma poling of poly(vinylidene fluoride): Piezo- and pyroelectric response, J. Appl. Phys. 51, No. 3, 1676-1681 (Mar. 1980).

76. McKnight, R. H. and Hebner, R. E., Jr., X-Cal--A calibration system for electrical measurement devices used with diagnostic x-ray units, NBSIR 80-2072, 75 pages (June 1980). Order from NTIS as PB 80-197478, $8.00.

The X-CAL high-voltage-divider calibration system was designed to calibrate the direct and alternating voltage measurement capabilities of commercial high voltage dividers used to characterize diagnostic x-ray units. In addition, there is capability for determining the frequency response of these dividers and for the calibration of the filament current and anode current measurement features of specific commercially-available devices. The calibration system combines in a single unit a range of capabilities which allows calibration of a device under test to be accomplished with a minimum of set up time.

77. Mordfin, L., Ed., NDE publications; 1978, NBSIR 80-2080, 22 pages (June 1980). Order from NTIS as PB 81-197691, $5.00.

78. Mordfin, L, Reliability of nondestructive evaluation, Critical Materials and Fabrication Issues for Pressure Vessels, Piping, Pumps, and Valves, J. T. Fong, R. C. Dobbyn and L. Mordfin, Eds., NBS Spec. Publ. 588, 55-58 (June 1980) SN003-003-02215-2, $4.25.

Establishing the reliability of NDE systems is more critical than improvements in NDE systems that foster small but uncharacterized improvements in reliability. The reliability of an NDE system cannot be established until the system is well characterized. This will require a methodology that is based on standards, well-defined systems, rigorous procedures and appropriate statistical analyses. Standardization of the newer NDE methods must be pursued, and research to characterize the contribution of the NDE inspector also merits high priority.

79. Mordfin, L., Payne, B. F. and Edelman, S., Enhanced reliability and reproducibility of measurements of machinery vibrations, Vibration Standards and Current Techniques for Flexible Rotor Balancing (Proc. 6th Machinery Dynamics Seminar), NRC No. 18899, pp. 4-1 to 4-22 (National Research Council Canada, Ottawa, Sept. 1980).

Using vibration measurements to monitor the condition of machinery offers several advantages over traditional methods of nondestructive evaluation. This paper reviews some of the activities being carried out at NBS in support of this measurement technology. NBS maintains a calibration service for vibration pickups and NBS studies on piezoelectric

polymer gages have pointed the way toward enhanced reliability in vibration monitoring applications.

80. Motz, J. W. and Danos, M., X-ray image information theory, National Measurement Laboratory - 1979 Technical Highlights, NBS Spec. Publ. 572, 29-30 (April 1980) SN003-003-02203-7, $4.25.

This study analyzes the dependence of image information content on x-ray exposure. With the employment of image processing techniques and modified x-ray spectra, it is possible to significantly reduce these exposures without loss of the visual image information.

81. Newbury, D. E., Myklebust, R. L, Heinrich, K. F. J. and Fiori, C. E., Specialist workshop on energy dispersive x-ray spectrometry, National Bureau of Standards--Apr. 23-25, 1979, Scanning 3, No. 1, 43-45 (1980).

Topics included advances in measuring the properties of solid state energy dispersive x-ray detectors, windowless x-ray detectors, artifacts in electron-excited energy dispersive spectra, and applications to x-ray fluorescence.

82. Noyce, J. R., Standards for the assay of radionuclides of solid environmental samples, Proc. ASTM Conf. Effluent and Environmental Radiation Surveillance, Johnson, VT, July 9-14, 1978, Am. Soc. Test. Mater. Spec. Tech. Publ. 698, pp. 309-326 (1980).

83. Nyyssonen, D., Calibration of optical systems for linewidth measurements on wafers, Semiconductor Microconductor Microlithography V 221, 119-126 (Society of Photo-Optical Instrumentation Engineers, Bellingham, WA, 1980).

In the proposed approach for thin layers, a small number of etched silicon-dioxide-on-silicon wafers can be used for calibration of a large class of wafer materials. Examples of wafer calibration data for filar, image-splitting and image-scanning systems are given. The problems associated with accurate linewidth measurement and calibration for thick layers are also discussed.

84. Porter, G., Nondestructive evaluation program announced, Dimensions/NBS 64, No. 4, p. 19 (May/June 1980).

In an effort to improve NDT methods used in aerospace manufacturing and to strengthen ties between private industry and government research, NBS and the Martin Marietta Corporation have begun two 6-month cooperative programs.

85. Porter, G., Neutron radiography used for inspecting jet engines, Dimensions/NBS 64, No. 10, p. 18 (Dec. 1980).

See abstract for No. 3.

86. Prosen, E. J., Microcalorimetry and its applications, HHS Publication (FDA) 80-8126, Radiological Health, pp. 147-153, Food and Drug Administration, Washington, DC, 1980.

The technique of microcalorimetry is illustrated briefly by the use of the NBS microcalorimeter for the determination of self-discharge of cardiac pacemaker batteries.

87. Prosen, E. J. and Colbert, J. C., A microcalorimeter for measuring self-discharge of pacemakers and pacemaker power cells, J. Res. Nat. Bur. Stand. (U.S.), 85, No. 3, 193-203 (May-June 1980).

The self-discharge heat losses of cardiac pacemaker power cells and pacemakers were investigated by microcalorimetry. Results were obtained with small alkaline, mercury and lithium-iodine batteries under open-circuit and external load conditions. Results obtained with "complete pacemakers" are also reported.

88. Rubin, A. I., Ed., Lighting issues in the 1980's, Nat. Bur. Stand. (U.S.), Spec. Publ. 587, 175 pages (July 1980) SN003-003-02218-7, $5.50.

The issues include: Factors Affecting Human Activities in the Built Environment; Establishment of Illuminance Levels; and Professional Development and Lighting Education.

89. Ruff, A. W., Debris analysis of erosive and abrasive wear, Proc. Int. Conf. on the Fundamentals of Tribology, Massachussetts Institute of Technology, Cambridge, MA, June 19-22, 1978, pp. 877-885 (1980).

Debris particles have been recovered from dry abrasion and erosion studies of AISI 1015 steel specimens. The size and morphology of the debris particles have been related to the wrok surface topography.

90. Ruff, A. W. and Blau, P. J., Studies of microscopic aspects of wear processes in metals, NBSIR 80-2058, 79 pages (June 1980). Order from NTIS as PB 80-208077, $8.00.

Wear experiments have been conducted in copper alloys and steels under dry sliding conditions in order to study the microscopic aspects of wear and the mechanisms involved. Wear debris particles have been recovered from the tests and compared in morphological characteristics between the materials. Micro-hardness measurements have also been made.

91. Ruthberg, S., A rapid cycle method for gross leak testing with the helium leak detector, Proc. 1980 30th Electronic Components Conf., San Francisco, CA, Apr. 28-30, 1980, pp. 128-134 (Institute of Electrickl and Electronics Engineers, New York, NY, 1980).

A new noncontaminating, dry gas, quantitative test method has been developed that permits gross leak measurements on hermetic packages. It provides rapid testing with a helium leak detector over the leak size

range of less than 1 x 10^{-5} to more than 1 atm·cm^3/s with a test gas of ~1% helium.

92. Sawyer, D. E. and Kessler, H. K., Laser scanning of solar cells for the display of cell operating characteristics and detection of cell defects, IEEE Trans. Electron. Dev. ED-27, No. 4, 864-872 (Apr. 1980).

A new optical scanning technique was developed to map solar-cell operation over the cell area and reveal several types of cell defects. The technique allows one to detect potentially harmful cracks with a sensitivity greater than any other optical technique reported previously, and it permits one to locate regions of poor metallization. It has also been used to determine efficacy of cell design and to study cell degradation processes. The scanning technique is nondamaging; it requires no electrical contacts to the cell other than those already present.

93. Schrack, R. A., Behrens, J. W. and Bowman, C. D., Nuclear fuel assay using resonance neutrons, National Measurement Laboratory - 1979 Technical Highlights, NBS Spec. Publ. 572, 108-109 (April 1980) SN003-003-02203-7, $4.25.

NBS is developing a technique that will produce images similar to the familiar x-ray image, that will show the distribution of any isotope desired. Using neutrons generated by the NBS linear accelerator, this technique--resonance neutron radiography--provides a unique tool for determining both distribution and content of any sample. The technique is being developed as a reference standard measurement system for the NBS Nuclear Technology Program.

94. Schrack, R. A., Behrens, J. W. and Bowman, C. D., Nuclear fuel assay using resonance neutrons, Dimensions/NBS 64, No. 4, 21-23 (May/June 1980).

See abstract for No. 93.

95. Shawker, T. A., Parks, S. I., Linzer, M., Jones, B., Lester, L. A. and Hubbard, V. S., Amplitude analysis of pancreatic B-scans: a clinical evaluation of cystic fibrosis, Ultrasonic Imaging 2, No. 1, 55-66 (Jan. 1980

Ultrasonic B-scan images of the pancreatic parenchyma were numerically analyzed. The dependence of the numerical values on the B-scan imaging mode, transducer properties, dynamic range compression curve, and operator scanning technique is discussed.

96. Shingleton, J. G., Cassel, D. E. and McCabe, M. E., Computer modeling of air leakage in a solar air heating system, Proc. 2d Annual Systems Simulation and Economic Analysis Conf., San Diego, CA, Jan. 23-25, 1980, SERI/TP-351-131, pp. 265-271 (U.S. Department of Energy/Solar Energy Research Institute, Golden, CO, 1980).

97. Shorten, F. J., Ed., NBS Reactor: Summary of activities July 1978 to June 1979, Nat. Bur. Stand. (U.S.), Tech. Note 1117, 236 pages (Apr. 1980) SN003-003-02170-9, $6.00.

This report summarizes all those programs which depend on the NBS reactor. It covers the period form July 1978 through June 1979. The programs range from the use of neutron beams to study the structure of materials to neutron radiography and nondestructive evaluations.

98. Silberstein, S., Air leakage measurements of an unpartitioned mobile home, NBSIR 80-2105, 27 pages (Aug. 1980). Order from NTIS as PB 80-226707, $6.00.

Air exchange rates of an unpartitioned mobile home were measured using SF_6 tracer in an environmental chamber.

99. Smith, C., Putting it all together; Alaskan pipeline weld criteria, Dimensions/NBS 64, No. 9, 2-5 (Nov. 1980).

100. Swartzendruber, L. J., Ives, L. K., Free, G. M. and Mehrabian, R., Nondestructive evaluation of non-uniformities in aluminum alloy plate, Paper Summaries, 1980 ASNT Fall Conference, 39-42 (American Society for Nondestructive Testing, Columbus, OH, Oct. 1980).

101. Swartzendruber, L., Boettinger, W., Ives, L., Coriell, S., Ballard, D., Laughlin, D., Clough, R., Biancaniello, F., Blau, P., Cahn, J., Mehrabian, R., Free, G., Berger, H. and Mordfin, L., NBS: nondestructive evaluation of nonuniformities in 2219 aluminum alloy plate - relationship to processing, NBSIR 80-2069, 235 pages (Dec. 1980). Order from NTIS.

The compositional homogeneity, microstructure, hardness, electrical conductivity and mechanical properties of 2219 aluminum alloy plates are influenced by the process variables during casting, rolling and thermo-mechanical treatment. These relationships have been investigated for deviations caused by improper quenching after solution heat treatment. Primary emphasis has been placed on the reliability of eddy current electrical conductivity and hardness as NDE tools to detect variations in mechanical properties.

102. Thomson, R. M., Understanding materials reliability - the mechanisms of fracture, Proc. DARPA/AFML Review of Progress in Quantitative Nondestructive Evaluation, D. O. Thompson and R. B. Thompson, Eds., Report AFWAL-TR-80-4078 159-166 (Air Force Wright Aeronautical Laboratories, Dayton, OH, July 1980).

For the benefit of the NDE community, a personal view will be given of the current status of our understanding of materials fracture. The implications for NDE are on two levels: (1) new insight generated by fundamental advances in the science of materials reliability will lead to new NDE tools; and (2) NDE techniques can and should be applied to further the fundamental understanding of reliability.

103. Treado, S. J., Thermal resistance measurements of a built-up roof system, NBSIR 80-2100, 28 pages (Oct. 1980). Order from NTIS as PB 81-140063, $6.50.

This report describes a technique for making in-place measurements of thermal resistance. This technique utilizes a combination of infrared thermographic imaging, surface heat-flow meters, and surface thermopiles. Roof thermal resistance determinations performed according to this measurement procedure are found to be very accurate.

104. Wadley, H. N. G., Feasibility of crack growth characterization in a plate geometry, Report AERE-G1846, 16 pp. (U.K. Atomic Energy Authority, Harwell, England, Oct. 1980).

The possibility has developed of uniquely characterising deformation and crack growth processes by analysis of their acoustic emission signals. This report examines the source characteristics that potentially could be deduced and discusses some of the technological limitations. It is concluded that a plate experiment is certainly a feasible proposition provided adequate transducers can be developed.

105. Yin, L. I., Trombka, J. I. and Seltzer, S. M., A small rugged imaging x-ray spectrometer: A Lixiscope with good energy resolution, Nucl. Instrum. Methods 172, 471-477 (1980).

A new prototype Lixiscope (Low Intensity X-ray Imaging Scope) is described for operation in the 20-200 keV region. In addition to good spatial resolution, the new prototype is capable of providing simultaneous gamma-ray or x-ray single-photon counting, imaging and energy resolution. These characteristics make the new prototype a compact and rugged device suited for possible low-flux imaging applications.

106. Yin, L. I., Trombka, J. I. and Seltzer, S. M., New position-sensitive hard x-ray specttometer, Rev. Sci. Instrum. 51, No. 6, 844-845 (June 1980).

See abstract for No. 105.

107. Yonemura, G. T., Rinalducci, E. J., Tibbott, R. L. and Fogelgren, L. A., Equal apparent conspicuity contours with five-bar grating stimuli, NBSIR 79-1925, 38 pages (May 1980). Order from NTIS as PB 80-199292, $6.00.

The report discusses the results of laboratory studies on equal conspicuity (contrast) contours using as the test stimuli five-bar grating patterns, with the results of other experiments in this series conducted by NBS.

108. Young, R. D., Vorburger, T. V. and Teague, E. C., In-process and on-line measurements of surface finish, CIRP Ann. 29, No. 1, 435-440 (Aug. 1980).

It is expected that optical techniques will be used increasingly for measurements of surface roughness because these techniques are inherently fast and three-dimensional. Four optical techniques are discussed and evaluated.

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