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NBS
PUBLICATIONS

NBSIR 83-2741

NDE Publications: 1981

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

May 1983



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Leonard Mordfin, Editor

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

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NDE PUBLICATIONS: 1981

Leonard Mordfin

Office of Nondestructive Evaluation
National Measurement Laboratory
National Bureau of Standards
Washington, D. C. 20234

1. Introduction

This is the fifth 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", and
NBSIR 81-2364, "NDE Publications: 1980".

This report provides bibliographic citations for publications that appeared in the open literature during the calendar year 1981. 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 media 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 directly support NDE, such as imaging and signal processing, 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 172 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 on 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. Anderson, W. E.; Ramboz, J. D., Technical contributions to the development of incipient fault detection/location instrumentation. NBSIR 81-2235, 1981 March. 134 p. Available from: NTIS; PB 81-188005, $12.50.

A measurement program has been initiated that will provide data on the rf properties of cables and on the characteristics of some forms of incipient faults. Preliminary measurements demonstrate the limitations of frequency- or time-domain-reflectometry techniques in the detection of incipient faults.

2. Anon., NBS helps NASA shuttle in new space era, NBS Standard 26, No. 8, 1 (April 15, 1981).

A comprehensive study that related alloy composition and process variables to microstructure, mechanical properties and nondestructive measurements allayed fears that defective aluminum may have been used in the space shuttle's external fuel tank.

3. Anon., Results of "soft aluminum" study announced, Dimensions/NBS 65, No. 4, 18 (May/June 1981).

See abstract for No. 2.

4. Anon., Semiconductor technology program progress briefs. NBSIR 81-2230-3. 1981 Nov. 12p.

This report provides information on the current status of NBS work on measurement technology for semiconductor materials, process control, and devices. Highlighted activities include an automatic scanning spectroscopic ellipsometer, linewidth measurement and coherence, and the evaluation of electrical linewidth uniformity.

5. Bean, V. E.; Long, F. G., Jr., Coal slurry level monitor developed, Dimensions/NBS 65, No. 6, 18-20 (Aug. 1981).

NBS researchers developed a magnetically coupled liquid-level sensor to track the level of a slurry of powdered coal in creosote within a pressurized steel vessel.

6. Belecki, N.B., New directions for standards concluded from workshop sessions, Eddy Current Nondestructive Testing, NBS SP 589, 149-154 (Jan. 1981).

Report on a discussion of the title subject, held at the Workshop on Eddy Current NDE in Nov. 1977 at NBS.

7. Belsher, D. G. Feasibility study on the use of a microwave system for the nondestructive evaluation of historic adobe structures. NBSIR 79-1610. 1979 July. 32 p. Available from: NTIS; PB 298559, $4.00.

A frequency-modulated continuous wave radar system has been utilized to provide usable on site information and to evaluate its potential for nondestructively measuring parameters associated with the soundness of historic adobe walls. The results indicate that an FM-CW system can nondestructively provide a major portion of the information needed to evaluate the soundness of adobe structures at a relatively low cost and in less time than present techniques.

8. Bennett, L. H.; Swartzendruber, L. J.; Reno, R. C. Nuclear hyperfine and positron annihilation methods for measurements of internal stress, Nondestructive Techniques for Measuring the Longitudinal Force in Rails, FRA/ORD-80/50, pp. 126-130 (U. S. Department of Transportation, Washington, DC, Dec. 1980). Available from: NTIS.

A brief review of Mossbauer effect, nuclear magnetic resonance, perturbed angular correlation, and positron annihilation is given and their potential for measurements of residual stress in rails is assessed.

9. Berger, H. The role of calibration in nondestructive evaluation, NCSL Newslett. 20, No. 4, 32-35 (Dec. 1980).

Improved procedures for NDE will play a key role as we move toward improved product quality. These NDE methods are briefly reviewed in this paper, with emphasis placed on calibration methods that are now available, or to be available shortly, to aid industry to achieve NDE measurement reproducibility. The contributions to high-reliability NDE that standards/metrology labs can provide are outlined.

10. Berger, H., ISO TC 135 holds plenary meeting in Moscow -- plans new start, Materials Evaluation 39, No. 4, 352 (March 1981).

11. Berger, H. Nondestructive testing in the 80's, Can. Soc. Nondestr. Test 2, No. 7, 14-18 (Apr. 1981).

12. Berger, H. An overview: New ideas in nondestructive evaluation, Rubber Chem. Technol. 54, No. 5, 996-1002 (1981).

Major changes are taking place in terms of modifications of standard methods and in terms of new inspection approaches. The discussion includes descriptions of modifications such as ultrasonic imaging, x-ray tomography, pulsed eddy current techniques and signal processing. In addition, novel NDE approaches that appear to offer advantages of tire inspection are discussed; these include acoustic emission, microwaves and vibrothermography.

13. Berger, H., Meeting report, third plenary meeting of ISO Technical Committee 135 on International Standards for NDT, Moscow, USSR, 9-11 December 1980, NDT Intl. 14, No. 4, 202 (Aug. 1981).

14. Berger, H., A new look at the NBS programme in NDE, NDT Intl. 14, No. 5, 292-293 (Oct. 1981).

Emphasis is on progress in calibration and Standard Reference Material activities.

15. Berger, H., The 1976 NBS study of girth welds in the Trans-Alaska pipeline, 1981 Paper Summaries, ASNT National Conferences, 198-200 (ASNT, Columbus, OH, 1981).

The problem concerned field-made girth welds in the Trans-Alaska oil pipeline. Many of these welds were shown, after they were put in place and covered over, to contain discontinuities larger than those permitted in the federal regulations. The study involved properties of the steel pipe and welds, fracture mechanics analysis and nondestructive measurements to size weld discontinuities. NBS results played a major role in the regulatory decision to waive requirements for three welds, thereby setting a precedent for a waiver based on fracture mechanics analysis.

16. Berger, H.; Mordfin, L., eds., Technical activities 1981 Office of Nondestructive Evaluation. NBSIR 82-2449. 1981 Dec. 120 p. Available from NTIS; $12.00.

This is the fourth in a series of annual reports describing the technical activities of the NDE program at NBS.

17. Berhinig, R. M., Measurement of air flow around doors under standardized fire test conditions. NBS-GCR-81-330. 1981 July. 40 p. Available from: NTIS; PB 81-238495, $6.50.

18. Berk, N. F.; Rowe, J. M., Color graphics amd imaging system, NBS Reactor: Summary of Activities July 1979 to June 1980, NBS TN-1142, 65-66 (May 1981).

The system was installed in 1980 for the NBS small-angle neutron scattering facility. It includes a high-resolution raster scan color TV monitor for image display and a minicomputer interface for image processing.

19. Berning, D. Use of vacuum tubes in test instrumentation for measuring characteristics of fast high-voltage semiconductor devices, IEEE Trans. Instrum. Meas. IM-30, No. 3, 226-227 (Sept. 1981).

Reference is made to a unique circuit that was built for performing nondestructive, reverse-bias, second-breakdown tests on transistors.

20. Birnbaum, G.; Free, G., eds. Eddy-Current Characterization of Materials and Structures, Am. Soc. Test. Mater. Spec. Tech. Publ. 722, 501 pages (ASTM, Philadelphia, PA, Feb. 1981).

Thirty-one papers cover the state-of-the-art in eddy-current research.

This comprehensive publication covers developments in theoretical models for specific eddy-current problems, the analysis of performance of available instrumentation, and microwave, multifrequency, and pulsed eddy-current methods.

21. Birnbaum, G.; Berger, H.; Eitzen, D. G. Traceable NDE standards, Proc. 13th Symp. on NDE, San Antonio, TX, 1981, 266-272 (NTIAC, San Antonio, TX).

Recent work at NBS which has led to NDE standards and calibrations, as well as work in progress, is reviewed.

22. Birnbaum, G.; Berger, H.; Eitzen, D. G, Traceable NDE standards, NTIAC Newsletter 9, No. 3, 1-4 (NTIAC, San Antonio, TX, Sept. 1981).

See abstract for No. 21.

23. Blau, P. J., A simple method for cross-sectional examination of wear debris flakes. Wear 66, 257-258 (1981).

This note covers a procedure for mounting and cross-sectioning thin flakes of metallic wear debris. The mounts can be used for metallographic studies of debris structure or for measurements of debris dimensions.

24. Bowman, C. D; Carlson, A. D.; Wasson, O. A.; Schrack, R. A.; Behrens, J. W.; Johnson, R. G.; Duvall, K. C. White source use in a neutron standards laboratory, Proc. IAEA Consultant's Meet. on Neutron Source Properties, Hungary, 1980, K. Okamoto, ed., pp. 119-134 (IAEA, Vienna, Austria, June 1980).

Methods are described for accurately characterizing the neutron beam from a white source in spectral shape, absolute intensity, and source brightness distribution. These methods can be implemented with a modest electron linac facility.

25. Breckenridge, F. R; Greenspan, M. Surface-wave displacement: Absolute measurements using a capacitive transducer, J. Acoust. Soc. Am. 69, No. 4, 1177-1185 (Apr. 1981).

We have constructed a capacitive transducer for the absolute measurement of the normal component of surface-wave motion on a flat solid, the direction of travel of the wave being known. The transducer backplate is a cylinder and has cylindrical extensions on each end that act as electrostatic guards to render calculable the sensitivity and capacitance of the transducer. Compliant support elements are incorporated, resulting in negligible mechanical loading to the surface and flat frequency response over the range of 10 kHz to 1 MHz or better. The upper limit to displacements measurable by this technique has not been established, but is large enough to encompass the range of interest.

26. Bullis, W. M. Advancement of reliability, processing and automation for integrated circuits with the National Bureau of Standards, NBSIR 81-2224. 1981 March. 50 p. Available from: NTIS; PB 81-188203, $8.00.

The program was undertaken in 1973 to develop the measurement technology necessary to enable device manufacturers to exert more effective control over the materials and processes they use to make integrated circuits with the ultimate aim of providing increased reliability at reasonable cost. Work was carried out in 12 technical areas including resistivity and dopant characterization; film and layer thickness; microelectronic test patterns; wafer inspection and test; and hermeticity.

27. Bullis, W. M., ed. Semiconductor technology program progress briefs. NBSIR 81-2230. 1981 March. 11 p. Available from: NTIS; PB 81-188120, $5.00.

This report provides information on the status of NBS work on measurement technology for semiconductor materials, process control, and devices. Highlighted activities include an analysis of the cross-bridge sheet resistance test structure, and advances in optical measurements of linewidth on wafers.

28. Bullis, W. M., ed. Semiconductor technology program - Progress briefs. NBSIR 81-2230-2. 1981 July. 16 p. Available from: NTIS; PB 238529, $5.00.

Highlighted activities include newly issued resistivity SRMs, design information for a set of wafer optical linewidth standards, acoustic-emission testing of tape-bonded ICs, and laser scanning of a solar cell test pattern.

29. Bullis, W. M.; Ehrstein, J. R. Reference materials and the semiconductor industry, Solid State Technol., pp. 56-63 (Nov. 1981).

The advent of many new measurement techniques and instruments, often noncontacting and automatic, has offered convenience to the user, but many times it is at the price of measurements which are inconsistent with those obtained by more traditional techniques. The Standard Reference Material (SRM) program at the National Bureau of Standards, which provides calibrated artifacts to various user communities, is one approach for improving measurement accuracy and compatibility. Application of the SRM program to the semiconductor industry is discussed both with respect to present and planned SRMs and with regard to meeting the more extensive and longer range needs of the industry.

30. Bur, A. J.; Tsao, A. K. Depolarization of poled PVF_2 samples with "thick" electrodes, Ferroelectrics 32, 185-189 (1981).

31. Bur, A. J. Resistivity and piezoelectric measurements on oriented and unoriented thick PVF_2 films, Polymer 22, 1288-1289 (Sept. 1981).

32. Cezairliyan, A. Electrical resistivity of molybdenum in the temperature range 1500 to 2650 K, Int. J. Thermophys. 1, No. 4, 417-427 (1980).

33. Chen, H.; Kuriyama, M. A high-resolution X-ray facility, J. Appl. Cryst. Lab. Note 14, 280 (1981).

An x-ray diffraction system capable of producing and detecting x rays with an angular resolution better than two seconds of arc has been developed.

34. Cheng, Y. T.; Ganoczy, M.; Garrett, D. A., Nuclear applications to antiquities, NBS Reactor: Summary of Activities July 1979 to June 1980, NBS TN-1142, 32-34 (May 1981).

Three test paintings were studied by both thermal-neutron induced-autoradiography and high-resolution gamma-ray spectroscopy as part of an effort to assess the suitability of the AFRRI reactor for this purpose.

35. Chew, H. Modelling of oil shale retorts for electromagnetic sensing techniques. NBSIR 81-1653. 1981 November, 47 p. Available from: NTIS; PB 82-153321.

We report on the modelling of oil shale retorts for electromagnetic sensing techniques. The aim is to obtain useful information about the contents of the retort. The results indicate feasibility of determining the void ratio by remote electromagnetic measurements.

36. Clark, H. E. Requirements for an effective national nonionizing radiation measurement system. Nat. Bur. Stand. (U. S.) Spec. Publ. 613; 1981 June. 41 p. SN003-003-02335-5.

37. Clifton, J. R.; Anderson, E. D. Nondestructive evaluation methods for quality acceptance of hardened concrete in structures. NBSIR 80-2163. 1981 January. 54 p. Available from: NTIS; PB 81-159618, $8.00.

Methods have been identified which provide information on the strength, quality and uniformity, thickness, air content, stiffness, finish, density of concrete as well as the location and condition of steel reinforcement. In addition, the feasibility of combining two or more test methods for improving the prediction of the strength or quality of concrete is explored.

38. Clifton, J. R; Pommersheim, J. M., Modeling of the maturity concept, 1981 Paper Summaries, ASNT National Conferences, 145-146 (ASNT, Columbus, OH, 1981).

The feasibility of using nondestructive evaluation methods for estimating the compressive strength of inplace concrete is being explored and some methods are slowly gaining acceptance in the construction field.

39. Clough, R. B.; Chang, J. C,; Travis, J. P. Acoustic emission signatures and source microstructure using indentation fatigue and stress corrosion cracking in aluminum alloy, Scr. Metall. 15, No. 4, 417-422, (April 1981).

Acoustic emission due to indentation is a new NDE technique for correlating acoustic emission with microstructure. Previous work demonstrates that reproducible acoustic emission signals can be generated in embrittled steels by incremental growth of cracks. Here the technique is illustrated for use in more ductile materials through indentation fatigue and indentation stress corrosion cracking.

40. Clough, R. B.; Simmons, J. A. Reproducible acoustic emission signatures by indentation in steels, Proc. DARPA/AFWAL Rev. of Progress in Quantitative NDE, La Jolla, CA, 1980, AFWAL-TR-81-4080, 241-242 (Sept. 1981).

See abstract for No. 41.

41. Clough, R. B.; Simmons, J. A. Reproducible acoustic emission signatures by indentation in steels, Mater. Eval 39, 1026-1031 (Oct. 1981).

Creating reproducible signals from defects is of importance for quantitative studies of acoustic emission (AE). A method for doing so is presented here which consists of indentation of hardened steel plates. A survey was made of a variety of steels, including A533B pressure vessel steel with an embrittled weld. In many cases, the signals were reproducible over an appreciable range and appeared to be similar, for epicenter measurements, to those produced by sudden unloading. However, monitoring on the same surface as the indentation in some cases produced sets of different but reproducible signals which gradually evolved with repeated loading. The method suggests itself for materials studies of AE as well as a nondestructive method for in situ examination of structures for embrittlement.

42. Cohn, J., Charting the world of radiography -- testing the visual acuity of radiographic inspectors, Dimensions/NBS 65, No. 7, 10-13 (Sept. 1981).

NBS researcher Gary Yonemura has drafted a new chart to test for visual acuity. The chart emphasizes the ability to see blurred lines that have a low contrast with their background.

43. Committee on Radiation Measurements, Directory of commercial calibration services for ionizing survey instruments. NBS-GCR-80-296. 1981 April. 73 p. Available from: NTIS; PB 81-20641, $9.50.

44. Danielson, B. L. Backscatter signature simulations. NBS TN-1050. 1981 Dec. 100 p. Available from: NTIS; PB 82-174186.

This report presents a collection of computer-generated backscatter signatures which represent realistic replicas of signals that can be encountered in optical time-domain reflectometer systems. Emphasis is placed on backscatter signatures from localized and distributed imperfections which are superimposed on an otherwise uniform optical fiber.

45. Datta, S. K.; Ledbetter, H. M.; Kinra, V. K. Wave propagation and elastic constants in particulate and fibrous composites, Composite Materials, K. Kawata and T. Akasaka, eds., pp. 30-38 (Japan Society for Composite Materials, Tokyo, 1981).

Dynamic elastic properties were studied both theoretically and experimentally. Particulate composites were studied in a through-transmission water-immersion tank, while the fiber composite was studied by both pulse-echo-overlap and resonance methods.

46. Datta, S. K.; Fortunko, C. M.; King, R. B., Sizing of surface cracks in a plate using SH waves, 1981 Ultrasonics Symp. Proc., Vol. 2, 836-867 (IEEE, Piscataway, NJ, 1981).

The diffraction of SH waves by two-dimensional surface cracks in isotropic plates is studied. It is shown that SH waves may be particularly appropriate for detecting and sizing elongated planar defects in butt welds.

47. DeReggi, A. S.; Roth, S. C; Kenney, J. M.; Edelman, S.; Harris, G. R. Piezoelectic polymer probe for ultrasonic applications, J. Acoustic. Soc. Am. 69, No. 3, 853-859 (Mar. 1981).

Miniature piezoelectric polymer hydrophones for ultrasonic field characterization in the low megahertz region have been developed and tested. The principal advantages of these devices over conventional hydrophones are their uniform frequency response and minimal perturbation of the field. These characteristics are achieved by rendering a small central region of a thin sheet of the polymer polyvinylidene fluoride locally piezoelectric and then supporting the sheet in the field by holding it taut in a metal hoop having dimensions larger than the field being probed. Both single elements having diameters less than 1 mm and multielement arrays have been formed on the polymer. Methods of construction, signal amplification, and, in one design, rf shielding are discussed, and data are presented on insertion loss, sensitivity, frequency response, and immunity to rf interference.

48. Deslattes, R. D.; Kessler, E. G.; Sauder, W. C.; Henins, A. Remeasurement of γ-ray reference lines, Ann. Phys. 129, No. 2, 378-434 (Oct. 15, 1980).

We have established a new significantly improved measurement chain connecting γ-ray lines with visible reference standards.

49. Dick, C. E.; Motz, J. W. Utilization of monoenergetic x-ray beams to examine the properties of radiographic intensifying screens, IEEE Trans. Nucl. Sci. NS-28, No. 2, 1554-1558 (Apr. 1981).

Monoenergetic x-ray beams are being utilized to examine the image information transfer properties of x-ray intensifying screens conventionally used in screen-film imaging systems. The technique of single photon counting is being employed to determine the relative probability distribution of the number of optical photons emitted from the screen after absorption of an incident x ray. These data can be used to

determine the average number of light quanta emitted per absorbed x ray. In addition, the shape of these distributions can be used to determine the image information transfer properties of a particular screen.

50. Dick, C. E.; Motz, J. W. Image information transfer properties of x-ray fluorescent screens, Med. Phys. 8, No. 3, 337-346 (May/June 1981).

The image information transer efficiency for five x-ray fluorescent screens (calcium tungstate, barium halide, and three rare earth screens) has been experimentally determined with monoenergetic x-ray beams. The transfer efficiency, which is defined by the ratio of the output to input signal-to-noise ratios, was determined from measurements of (a) the fraction of incident x rays absorbed in the screen and (b) the statistical distribution of the number of light photons emitted from the screen per absorbed x ray. Comparisons of the information transfer efficiency, the average number of light photons emitted per absorbed x ray, and the light output energy per Roentgen are given.

51. Duvall, K. C.; Wasson, O. A. The NBS 14 MeV absolute neutron beam facility, IEEE Trans. Nucl. Sci. NS-28, No. 2, 1488-1489 (Apr. 1981).

A 14 MeV absolute neutron beam has been established at the NBS 3 MV positive-ion Van de Graaff Accelerator Laboratory. The facility may be used to measure the absolute response of active neutron monitoring devices with high accuracy.

52. Edelman, S., Piezoelectric polymer sensors for NDE, Nondestructive Evaluation of Turbines and Generators, 1980 Conference and Workshop, EPRI WS-80-133, pp. 8-1 to 8-11 (EPRI, Palo Alto, CA, July 1981).

Piezoelectric polymer gages have been demonstrated to be useful in a number of applications on operating machinery at moderate temperatures. The technology can be extended to steam operating temperatures.

53. Eitzen, D. G.; Breckenridge, F. R.; Clough, R. B.; Fuller, E. R.; Hsu, N. N.; Simmons, J. A. Summary of fundamental developments for quantitative acoustic emission measurements, Report No. EPRI NP-1877, 100 pages (Electric Power Research Institute, Palo Alto, CA, June 1981).

The intent of this report is to summarize the results and methods of the research. Another report with more details of the research has been prepared for the specialist. See No. 56.

54. Eitzen, D. G; Berger, H.; Birnbaum, G. A basis for traceable NDE measurements. Part 1, Mater. Eval. 39, No. 9, 797-798 (Aug. 1981).

NBS is beginning to provide traceability for a number of NDE measurement procedures, an activity that is expected to have a 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 also

available or are being developed in radiography, eddy currents, magnetic particles, liquid penetrants and visual testing. Part 1 deals with the standards activities in ultrasonics.

55. Eitzen, D. G.; Berger, H.; Birnbaum, G., A basis for traceable NDE measurements, Part 2, Mater. Eval. 39, No. 10, 886-888 (Sept. 1981).

See abstract for No. 54.

56. Eitzen, D. G.; Breckenridge, F. R.; Clough, R. B.; Fuller, E. R.; Hsu, N. N.; Simmons, J. A. Fundamental developments for quantitative acoustic emission measurements, Report No. EPRI NP-2089, Project 608-1, 213 pages (Electric Power Research Institute, Palo Alto, CA, Oct. 1981).

This report describes Phase 1 of a research progrem supported jointly by the Electric Power Research Institute and the National Bureau of Standards on the development of the acoustic emission technique of surveying technical integrity. The work has focused on: improved test standardization through the development of a calibration capability for AE sensors; improved sensor concepts and techniques for field and laboratory calibration; an improved basis for understanding and predicting AE behavior through the development of a mathematical framework for AE (transfer function formalism) through specific theoretical solutions to AE generation, transmission and inversion problems and the successful application of these theories to actual events in glass; an improved basis for assessing defect significance through the development of improved signal processing and inversion methods and through experimental results from AE in pressure vessel steels; the implementation of experiments to establish the feasibility of using causal methods, based on theoretical mechanics, to obtain source information in structural steels.

57. Eisenhower, E. H, Chairman, ANSI Subcommittee N43-3.5 Radiological safety for the design and construction of apparatus for gamma radiography. (ANSI N432-1980). Nat. Bur. Stand. (U.S.) Handb. 136: 1981 January. 19 p. SN003-003-02293-4, $1.50.

This standard applies to the design and construction of apparatus used for industrial gamma radiography which employs radioactive material as the energy source. It establishes the criteria to be used in the proper design and construction of the various components to ensure a high degree of radiation safety at all times. The testing procedures and equipment for the various classifications of the exposure devices and source assemblies are detailed.

58. Ellerbruch, D. A., Non-destructive testing with microwaves, 1981 Paper Summaries, ASNT National Conferences, 147 (ASNT, Columbus, OH, 1981).

Microwave signals will propagate into gravel, soil, concrete, asphalt, snow and adobe materials and are sensitive to moisture, density, thickness, voids and other anomalies. It is possible, therefore, to use a microwave system for nondestructively evaluating a volume of material to obtain

knowledge about its uniformity, voids, moisture or other internal anomalies.

59. Elsley, R. K.; Fortunko, C. M., Improvements in flaw detection in austenitic stainless steel weldments, 1981 Ultrasonics Symp. Proc., Vol. 2, 892-899 (IEEE, Piscataway, NJ, 1981).

Inspection of austenitic stainless steel weldments by conventional ultrasonic means is limited by the textured grain structure of the weld metal. It is shown that for selected angles of incidence, shear waves polarized normal to the grains can pass through the weld metal-base metal interface without partial reflection. As a consequence, the inspectability of stainless steel weldments can be improved. The use of low frequency probing signals is advantageous because it reduces the influence of nonuniform textures at the interface. The operation of a low frequency ultrasonic system for stainless steel butt weldments using electromagnetic acoustic transducers is demonstrated.

60. Escalante, E.; Bertocci, U.; Mullen, J.; Cohen, M.; Kruger, J. Development of in situ techniques for the detection of corrosion of copper concentric neutrals of electric cables in underground environments, Proc. IEEE Power Engineering Society 1981 Transmission and Distribution Conf. & Exposition, Paper No. 81 TD 623-8, pp. 1-7 (1981).

Measurements have demonstrated the utility of electrochemical polarization measurements in detecting and measuring the corrosion of buried CCN. It has also been demonstrated that the polarization measurements can be carried out on operating cables. Techniques for the measurement of the voltage and current fluctuations of corroding electrodes (corrosion noise) are described. These techniques are being investigated for their use in the detection of corrosion of CCN cables. They have been applied in the laboratory, and preliminary tests have been carried out on buried cables.

61. Fiori, C. E.; Myklebust, R. L. A simple method for fitting Gaussian profiles to x-ray spectra obtained with an energy-dispersive detector, Computers in Activation Analysis and Gamma-Ray Spectroscopy, B. S. Carpenter, M. D. D'Agostino, and H. P. Yule, eds., CONF-780421, pp. 139-149 (U. S. Department of Energy, Technical Information Center, Washington, DC, 1979).

A method is described for the fitting of Gaussian profiles to the pulse-height distributions of overlapping X-ray peaks measured with an energy-dispersive detector. The desired result is to know the areas under individual X-ray peaks in a spectrum in which the peaks are not resolved.

62. Fong, J. T; Dobbyn, R. C.; Mordfin, L.; Johnson, B. M., eds., Critical Issues in Materials and Mechanical Engineering, PVP-Vol. 47, Bk. No. H00183, 276 p. (ASME, N.Y., 1981).

This volume presents dialogue surrounding the controversial issues of inspection, fabrication, and operation of critical components, and failure-related issues.

63. Fong, J. T., ed., Non-Destructive Evaluation (NDE); Reliability and Human Factors -- A Symposium Preview, 140 p. (Oct. 1, 1981).

This document was prepared for advance distribution to the participants in the ASME-ASNT-NBS symposium on NDE reliability and human factors which was held in Atlanta, GA on Oct. 12-13, 1981. Abstracts of most of the papers are included.

64. Fong, J. T., Safety factor in defect sizes: a combined statistical and engineering approach, 1981 Paper Summaries, ASNT National Conferences, 203-205 (ASNT, Columbus, OH, 1981).

A generic problem in sizing a weld defect is the estimation of uncertainties associated with (a) the measurement process, (b) sampling, and (c) human factors. A combined statistical and engineering approach to quantify the uncertainty estimate is proposed. A rational basis for choosing a safety factor on defect sizes is discussed.

65. Fortunko, C. M. Ultrasonic detection and sizing of two-dimensional weld defects in the long-wavelength limit, Proc. 1980 Ultrasonics Symp., pp. 862-867 (Institute of Electrical and Electronics Engineers, New York, NY, 1980).

A new ultrasonic inspection technique is described for detecting elongated defects in butt-weldments. The technique can be used to detect and size two-dimensional defects which can potentially impair the fitness-for-purpose condition of pipeline girth welds. The defect sizing is accomplished by inverting long-wavelength scattering data obtained with shear-horizontal (SH) waves. Noncoupling, electromagnetic-acoustic transducers are used to excite and detect the SH-wave probing signals.

66. Fortunko, C.M. Ultrasonic detection and sizing of two-dimensional defects at long wavelengths, Appl. Phys. Lett. 38, No. 12, 980-982 (June 15, 1981).

An ultrasonic technique is described for detecting and sizing of two-dimensional defects. The technique is particularly suitable for detecting two-dimensional defects in certain butt-weldments which cannot be fully inspected by conventional radiographic and ultrasonic methods. Use is made of noncontact, electromagnetic-acoustic transducers to excite and detect shear horizontal (SH) wave probing signals where wavelength is long compared to the defect depth dimensions.

67. Fortunko, C. M.; MacLauchlan, D. Pulsed electromagnets for EMATs, Proc. DARPA/AFWAL Rev. of Progress in Quantitative NDE, La Jolla, CA 1980, AFWAL-TR-81-4080, 528-534 (Sept. 1981).

Pulsed electromagnets may be more desirable than large static electromagnets or permanent magnets for magnetic biasing of electromagnetic acoustic transducers. The transduction efficiency can be enhanced by the dynamic concentration of the magnetic flux near the surface. For maximum transduction efficiencies the ultrasonic pulse must be retarded relative to the initiation of the current pulse to the electromagnet windings. A second maximum is observed when the system is operated on ferromagnetic steel. Operation of pulsed systems at elevated temperatures is demonstrated on aluminum.

68. Fortunko, C. M.; Schramm, R. E., A long wavelength ultrasonic technique for detecting and sizing weld defects, 1981 Paper Summaries, ASNT National Conferences, 346-348 (ASNT, Columbus, OH, 1981.)

By operating in the long wavelength regime, the SH-wave-EMAT technique is less sensitive to defect orientation and surface roughness than conventional ultrasonic techniques. It is useful for sizing weld defects because, in the long wavelength regime, the amplitude of ultrasonic reflections increases monotonically with defect size. In addition, it has enhanced sensitivity to weld defects because SH-waves do not reflect strongly from the weld reinforcement (crown). Because EMATs do not require intimate contact, ultrasonic inspections of weldments can be reliably carried out over most unprepared surfaces and in adverse environments.

69. Fortunko, C. M. Ultrasonic evaluation of austenitic stainless steel welds using shear horizontal waves, Appl. Phys. Lett. 39, No. 9, 699-700 (Nov. 1, 1981).

The propagation of horizontally polarized shear waves through an austenitic stainless steel weld metal-base metal interface is described. It is shown that SH wave probing singals are particularly suitable for weldments that are difficult to evaluate using vertically polarized shear and longitudinal wave probing signals. The technique is demonstrated experimentally.

70. Free, G., ed., Eddy Current Nondestructive Testing. Nat. Bur. Stand. (U. S.) Spec. Publ. 589; 1981 January. 153 p. SN003-003-02287-0. $5.50.

The proceedings of the Eddy Current Nondestructive Testing Workshop held at NBS in November, 1977 contains papers related to all areas of eddy current testing. A historical overview of the discipline from its inception until the present is given. Other papers discuss eddy current testing in the primary metals industry (both ferrous and nonferrous), the use of eddy currents for sorting of metals and for defect detection, the state-of-the-art in eddy current instrumentation, and signal processing in the analysis of eddy current signals. The development and use of eddy current standards are discussed as well as several of the newer areas of eddy current development, i.e., multifrequency and pulsed eddy current techniques.

71. Free, G. M., NBS eddy current standards program, Eddy Current Nondestructive Testing, NBS SP 589, 133-136 (Jan. 1981).

The goals of the NBS eddy current program are twofold: the creation of an electrical conductivity calibration service for nonferrous metal standards, and the development of nonferrous metal Standard Reference Materials to be issued as conductivity standards. The calibration service will provide measurements of the electrical conductivity of standards sent to NBS by industry. The SRM Program will make available to industry electrical conductivity standards suitable for use in calibrating eddy current instrumentation.

72. Free, G., High-accuracy conductivity measurements in nonferrous metals, Eddy-Current Characterization of Materials and Structures, ASTM STP 722, 121-128 (1981).

An eddy-current instrument has been built that measures electrical conductivity with a high degree of accuracy and precision. By keeping the product $\omega\sigma$ constant in all measurements, a linear relationship between conductivity and frequency can be established. Due to this linear relationship, only one conductivity standard is necessary to calibrate the instrument over the full range of 1 to 100 percent international annealed copper standard (IACS).

73. Garrett, D. A.; Steinbring, R. C; Ganoczy, M., The use of neutron and x-radiography to evaluate lithium/iodine pacemaker batteries, NBS Reactor: Summary of Activities July 1979 to June 1980, NBS TN-1142, 50-57 (May 1981).

Neutron radiography was used to study internal changes in lithium/iodine batteries during accelerated discharge. Neutron and x-radiography complement each other in this application. By utilizing mass absorption coefficients the battery constituents can be tracked as a function of cell discharge.

74. Garrett, D. A.; Barrow, J. J., Thermal neutron imaging screen development, NBS Reactor: Summary of Activities July 1979 to June 1980, NBS TN-1142, 57-58 (May 1981).

75. Glinka, C. J.; Rowe, J. M.; LaRock, J. G., The small-angle scattering facility, NBS Reactor: Summary of Activities July 1979 to June 1980, NBS TN-1142, 66-69 (May 1981).

A new facility for small-angle neutron scattering (SANS) is under construction at the NBS Reactor.

76. Golan, S., Optimization of the crack tip ultrasonic diffraction technique for sizing of cracks, Materials Evaluation 39, No. 2, 166-169 (Feb. 1981).

Four parameters influence the efficacy of the ultrasonic diffraction technique for sizing of cracks: strength of the ultrasonic beam diffracted from the tip of the crack, accuracy of sizing of the crack, range (a parameter related to the area covered by the ultrasonic field) and surface resolution which determines the limits of crack size that can be measured. The influence of these parameters on the quality of the test and optimization of the test conditions are discussed.

77. Greenspan, M., Acoustical research in the physical sciences: properties of gases, liquids and solids, J. Acoust. Soc. Am. 68 , No. 1, 29-35 (July 1980).

This paper reviews research during the past 50 years on the relation between acoustical behavior, mainly velocity and attenuation of sound, and the properties of gases, liquids, and solids.

78. Gross, D. A review of measurements, calculations and specifications of air leakage through interior door assemblies. NBSIR 81-2214. 1981 January. 25 p. Available from: NTIS; PB 81-179178. $5.00.

79. Grot, R. A. A low-cost method for measuring air infiltration rates in a large sample of buildings, Building Air Change Rate and Infiltration Measurements, Am. Soc. Test. Mater. Spec. Tech. Publ. 719, C. M. Hunt, J. C. King, H. R. Trechsel, eds., pp. 50-59 (Oct. 1980).

80. Grot, R. A; Clark, R. E. Air leakage characteristics and weatherization techniques for low-income housing, Proc. ASHRAE/DOE/ORNL Conf. Thermal Performance Exterior Envelopes of Buildings, ASHRAE SP 28, pp. 178-194 (American Society of Heating, Refrigeration and Air-Conditioning Engineers, NY, 1981).

81. Harman, G. G, Semiconductor measurement technology: nondestructive tests used to insure the integrity of semiconductor devices with emphasis on acoustic emission techniques, Intl. Adv. in NDT 7, 105-179 (Gordon & Breach, N.Y., 1981).

The discussion is divided into two major sections. The first consists of an introduction to device assembly techniques and problems followed by a review of six important nondestructive tests used during and after device packaging to insure the mechanical integrity of completed electronic devices. The second section begins with an introduction to acoustic emission, the status of theory as it can be applied to microelectronics. Then the published papers that have applied AE as a nondestructive test in electronics applications will be reviewed. Finally passive AE techniques are applied to establishing the mechanical bond integrity of beam lead, flip chip, and tape-bonded integrated circuits as well as components in hybrid microcircuits.

82. Hasegawa, S. Moisture sensors, Semiconductor Measurement Technology: ARPA/NBS Workshop V. Moisture Measurement Technology for Hermetic Semiconductor Devices, NBS SP 400-69, 126-127 (May 1981).

The miniature humidity sensors which are to be enclosed in hermetic semiconductor devices are still in the beginning stages of development. However, a great deal of effort is being expended to rapidly advance the state of the art for measurement of humidity and/or the total moisture content of hermetic semiconductor packages.

83. Heinrich, K. F. J.; Newbury, D. E; Myklebust, R. L.; Fiori, C.E., eds., Energy dispersive x-ray spectrometry. Nat. Bur. Stand. (U.S.) Spec. Publ. 604; 1981 June. 441 p. SN003-003-02333-7, $9.00.

This book is the formal report of the Workshop on Energy Dispersive X-Ray Spectrometry held at the National Bureau of Standards, April 23-25, 1979.

84. Hsu, N. N., Experimental determination of point impact force-time function, Extended Summaries, 1980 4th SESA Intl. Cong. on Exptl. Mechanics, 48-49 (SESA Westport, CT, 1980).

A test procedure to determine the force-time function of a short duration point impact force is described. The procedure has been used to calibrate ultrasonic transducers as a pulsed stress wave generator or

sensor, to characterize acoustic emission, and to study brittle fracture due to dynamic indentations.

85. Hsu, N.N.; Eitzen, D. G., AE signal analysis -- laboratory experiments examining the physical processes of acoustic emission, Proc. Fifth Intl. Acoustic Emission Symp., 67-78 (Japan Soc. for Non-Destructive Inspection, Tokyo, 1980).

We have studied the physical processes of AE from the generation of the stress waves at the source to the wave propagation in the structure, to the conversion into electrical voltage signals through a combination of analysis, design and conduct of controlled experiments.

86. Hsu, N. N.; Breckenridge, F. R. Characterization and calibration of acoustic emission sensors, Materials Evaluation 39, No. 1, 60-68 (ASNT, Columbus, OH, Jan. 1981).

Various calibration techniques are compared in terms of underlying principles and assumptions, specific methods and procedures, and limitations and advantages. The helium gas jet technique and the reciprocity technique are reviewed. The step-force calibration technique is described in detail. Sample calibration results of a commercial sensor are shown.

87. Hunt, C. M. Air infiltration: A review of some existing measurement techniques and data, Building Air Change Rate and Infiltration Measurements, Am. Soc. Test. Mater. Spec. Tech. Publ. 719, C. M. Hunt, J. C. King, H. R. Trechsel, eds., pp. 3-24 (Oct. 1980).

88. Jenkins, D. R.; Mathey, R. G; Knab, L.I. Moisture detection in roofing by nondestructive means - A state-of-the-art survey. Nat. Bur. Stand. (U.S.) Tech. Note 1146; 1981 July. 82 p. SN003-003-02340-0, $4.25.

A literature survey is presented of nondestructive evaluation methods for detection of moisture in roofing systems. The methods discussed include the use of capacitance-radio frequency instruments, capacitance-microwave instruments, nuclear meters, and thermal infrared scanners. For each method, the principles of operation are reviewed and the measured properties which are affected by moisture are identified. Factors other than moisture which may affect the response of the instruments are also described for each method.

89. Jesch, R. L. Dielectric measurements of five different soil textural types as functions of frequency and moisture content. NBSIR 78-896. 1978 October. 26 p. Available from: NTIS; PB 291944, $4.00.

Open-circuit coaxial transmission-line sample holders were used to determine the electromagnetic dielectric properties of five soil textural types as functions of moisture level content and frequency. A brief outline of the theoretical basis is given for the method along with the measurement system and the sample preparation.

90. Johnson, R. G.; Behrens, J. W.; Bowman, C.D. Source imaging using neutron pinhole cameras based on position-sensitive proportional counters, Nucl. Technol. 55, 724-727 (Dec. 1981).

A pinhole camera technique has been used to measure the variation in neutron emission intensity over the area of the neutron-producing target of the NBS Electron Linac. The method uses a one-dimensional position-sensitive proportional counter with an intrinsic spatial resolution of 1.0 mm. The pinhole is made in a thick sheet of cadmium and neutron energy selection is achieved by time-of-flight. A completely separate experiment demonstrated the use of the two-dimensional detector for imaging high-energy neutrons.

91. Jones, R. N.; Bussey, H. E.; Little W. E.; Metzker, R. F. Electrical characteristics of corn, wheat, and soya in the 1-200 MHz range. NBSIR 78-897. 1978 October. 70 p. Available from: NTIS; PB 289812, $4.50.

A set of coaxial sample holders together with a measurement and data reduction technique has been developed and applied to the study of the dielectric properties of wheat, corn and soya. Particular attention was given to the properties as a function of moisture content, frequency and packing density.

92. Kahn, A. H.; Spal, R. D., Electromagnetic theory and its relationship to standards, Eddy Current Nondestructive Testing, NBS SP 589, 137-141 (Jan. 1981).

We report on calculations of the eddy current and impedance changes associated with a surface crack in a plane slab and on a cylinder.

93. Kahn, A. H.; Spal, R., A boundary integral equation method for calculating the eddy-current distribution in a long cylindrical bar with a crack, Eddy-Current Characterization of Materials and Structures, ASTM STP 722, 298-307 (1981).

We report calculations of the impedance of a long solenoid which surrounds a cylinder of conducting material containing a crack. The results are displayed in graphical form, which gives the fractional changes of the real and imaginary parts of the impedance caused by the presence of the crack.

94. Kasen, M. B.; Mikesell, R. P., Effect of blunt flaws studied in pipeline girth welds, Oil & Gas J. 79, No. 13, 155-158 (PennWell Publ. Co., Tulsa, OK, March 30, 1981).

Experiments are being performed to determine if slag, porosity, or arc strikes significantly contribute to brittle fracture of pipeline girth welds.

95. Knab, L.; Mathey, R.; Jenkins, D. Laboratory evaluation of nondestructive methods to measure moisture in built-up roofing systems, Nat. Bur. Stand. (U. S.) Bldg. Sci. Ser. 131; 1981 January. 173 p. SN003-003-02281-1, $5.50.

This laboratory study investigated the reliability and accuracy of three types of nondestructive evaluation methods to quantitatively determine the moisture content of the insulation in built-up roofing specimens. These methods were electrical capacitance, nuclear backscatter, and infrared thermography. Two performance characteristics of the NDE methods were evaluated: (a) the minimum moisture content a method could detect, and (b) the relationship bewteen NDE response and moisture content beyond the minimum detectable moisture content.

96. Knab, L.I.; Mathey, R. G; Jenkins, D. R, NDE methods to measure moisture in built-up roofing systems, Dimensions/NBS 65, No. 3, 22 (April 1981).

See abstract for No. 95.

97. Knab, L. I.; Mathey, R. G.; Jenkins, D. R, Laboratory evaluation of nondestructive methods to measure moisture in built-up roofing systems, 1981 Paper Summaries, ASNT National Conferences, 148-149 (ASNT, Columbus, OH, 1981).

See abstract for No. 95.

98. Kriz, R. D., Absorbed moisture and stress-wave propagation in graphite/epoxy, Composites Technology Review 3, No. 4, 154-155 (ASTM, Philadelphia, PA, 1981).

99. Kuriyama, M. Residual stress measurements using energy dispersive diffractometry and high energy incident photons, Proc. of Symp. on Nondestructive Measurement of Wheel/Axle Residual Stress, Cambridge, MA, June 16-17, 1981, pp. 2.10.1-2.10.13 (U. S. Department of Transportation, Federal Railroad Administration, Cambridge, MA).

The application of energy dispersive diffractometry using high energy photons to monitor the structural integrity of industrial materials is described. X-ray optical conditions and counting statistics are studied in several transmission experiments using commercial steel plates almost one inch thick. A residual stress distribution across a weld zone in an Alaskan pipeline segment is obtained by the energy dispersive diffractometry method. This result demonstrates the potential capability of this technique as an industrial inspection tool.

100. Ledbetter, H. M. Dynamic elastic modulus and internal friction in G-10CR and G-11CR fibreglass-cloth-epoxy composites, Cryogenics 20, No. 11, 673-640 (Nov. 1980).

Young's moduli were determined dynamically for two fibreglass-cloth-epoxy composites in the wrap, fill, and normal directions between room temperature and liquid-nitrogen temperature.

101. Ledbetter, H. M.; Maerz, G. Temperature dependence of Young's modulus and internal friction of G-10CR and G-11CR epoxy resins, Cryogenics 20, No. 11, 655-658 (Nov. 1980).

Young's moduli of the epoxy-resin matrix material used in G-10CR and G-11CR fibreglass-cloth-reinforced composites were measured dynamically and semi-continuously between ambient and liquid-nitrogen temperatures.

102. Ledbetter, H. M. Sound velocities and elastic constants of steels 304, 310, and 316, Met. Sci. Tech. Note 14, No. 12, 595-596 (Dec. 1980).

Room temperature ultrasonic velocities, longitudinal and tranverse, were measured in three austenitic stainless steels. Elastic constants were computed from these velocities.

103. Ledbetter, H. M.; Moulder, J. C.; Austin, M. W. Young's modulus of a copper-stabilized niobium-titanium superconductive wire, Wire, 3 pages (Jan. 1981).

Two methods were used: continuous-wave-resonance and laser-pulse-excitation.

104. Ledbetter, H. M. Elastic constants and internal friction of fiber-reinforced composites, Composite Materials, K. Kawata and T. Akasaka, eds., pp. 65-70 (The Japan Society for Composite Materials, Tokyo, 1981).

Materials that were studied include: boron-aluminum, boron-epoxy, graphite-epoxy, glass-epoxy, and aramid-epoxy. In all cases, elastic-constant direction dependence could be described by relationships developed for single crystals of homogeneous materials. Elastic stiffness and internal friction were found to vary inversely.

105. Ledbetter, H. M. Elastic constants of polycrystalline copper at low temperatures, Phys. Status Solidi (A) 66, 477-484 (1981).

Elastic constants of polycrystalline copper are determined between 4 and 295 K by measuring ultrasonic velocities, longitudinal and transverse. Considering eight theories of single-crystal:polycrystal elastic constants the Hershey-Kroner-Eshelby theory agrees best with observation, within 1% for the shear modulus. (Voigt and Reuss first-order bounds differ by 29%.) A problem exists concerning the calculation of the Debye temperature of polycrystalline aggregates.

106. Ledbetter, H. M., Stainless steel elastic constants at low temperatures, J. Appl. Physics 52, No. 3, Part 1, 1587-1589 (Mar. 1981).

Elastic constants for stainless steels have been redetermined at cryogenic temperatures with an improved measurement system to provide additional information on the anomalous behavior of these steels at temperatures below 50 K. Longitudinal and transverse ultrasonic velocities were determined with a pulse-echo system.

107. Ledbetter, H. M. Predicted single-crystal elastic constants of stainless-steel 316, Br. J. Non Destr. Test. 23, No. 6, 286-287 (Nov. 1981).

The author gives an improved prediction of the three elastic-stiffness constants which determine the optimum direction for acoustic beams used to locate and size flaws. The predictive method applies to all cubic-crystal-structure anistropic materials.

108. Lederer, P. S. Sensor handbook for automatic test, monitoring, diagnostic, and control system applications to military vehicles and machinery. Nat. Bur. Stand. (U. S.) Spec. Publ. 615; 1981 October. 450 p. SN003-003-02372-8.

The Sensor Handbook is intended as a guide for those who design, specify, use, and test military automatic test equipment containing sensors. The Handbook addresses measurands and principles of measurement, data acquisition, sensor calibration and testing, environmental considerations, stability, durability, reliability, and error assessment.

109. Linzer, M., Ed., Ultrasonic imaging 3, Nos. 1, 2, 3, 4 (Academic Press, NY, Jan., April, July, Oct. 1981).

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.

110. MacDonald, D. E, On determining stress and strain and texture using ultrasonic velocity measurements, IEEE Trans. on Sonics and Ultrasonics SU-28, No. 2, 75-79 (March 1981).

The application of ultrasonics to NDE of residual stresses has been hindered by the question of whether the wave velocity is actually stress or strain dependent and by the confusion of the stress/strain related anistropy with that due to orientation texture. The ultrasonic wave velocity is shown to depend on the stress as well as on the strain-dependent second-order elastic coefficients. The direct stress dependence of the ultrasonic velocity reflects the fact that wave propagation in stressed materials is fundamentally different from the stress-free case. A comparison of wave speeds for materials with symmetry, and these same materials under uniaxial strain, are presented to indicate how to separate the effects of stress and texture.

111. McCulloh, K. E.; Tilford, C. R. Nitrogen sensitivities of a sample of commercial hot cathode ionization gage tubes, J. Vac. Sci. Technol. 18, No. 3, 994-996 (Apr. 1981).

112. Miller, E. B.; Yaghjian, A. D. Two theoretical results suggesting a method for calibrating ultrasonic transducers by measuring the total nearfield force, J. Acoust. Soc. Am. 66, 1601-1608 (Dec. 1979).

113. Mordfin, L., Reliability of nondestructive evaluation, Critical Issues in Materials and Mechanical Engineering, PVP-Vol. 47, Bk. No. H00183, 133-147 (ASME, N. Y., 1981).

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.

114. Mordfin, L.; Berger, H. NDE standards for nuclear power systems: An NBS perspective, Nondestructive Evaluation in the Nuclear Industry - 1980, pp. 303-318 (American Society for Metals, Metals Park, OH, 1981).

The most effective approach toward achieving standardization in new NDE measurement methods is described and illustrated by examples of recent and on-going activities at NBS.

115. Mordfin, L. Measurement of residual stresses: Problems and opportunities, Residual Stress for Designers and Metallurgists, L. J. Vande Walle, ed., pp. 189-209 (American Society for Metals, Metals Park, OH, 1981).

Existing methods for measuring residual stresses are limited in their capabilities and uncertain in their results. Problems exist in the interpretation of the measured data, and in the detection of sharp stress gradients in the interiors of members. Research is needed to clarify the confusing effects of microstructural features on nondestructive residual stress measurements, and there is need for dependable approaches to selecting the appropriate materials constants and conversion factors to be used. There is also a critical absence of adequate reference standards for calibrating or verifying the measurement techniques and equipment as well as an ever-present need for improvements in technique.

116. Mordfin, L. Introduction to residual stress measurement, Proc. Symp. on Nondestructive Measurement of Wheel/Axle Residual Stress, Cambridge, MA, June 16-17, 1981, pp. 2.1.1-2.1.19 (U. S. Department of Transportation, Federal Railroad Administration, Cambridge, MA).

The origins and the effects of residual stresses are described, and several of the more prominent methods of measuring residual stresses are reviewed. The principal emphasis is on the relative capabilities and limitations of the various methods.

117. Mordfin, L., ed., NDE publications: 1979. NBSIR 81-2351. 1981 October. 30 p. Available from: NTIS; $8.50. PB83-184630.

118. Mordfin, L., ed., NDE publications: 1980. NBSIR 81-2364. 1981 October. 44 p. Available from: NTIS; $8.50. PB83-184622.

119. Motz, J. W.; Dick, C. E.; Danos, M. Exposure limits imposed by screen-film systems on the transfer of image information, Applications of Optical Instrumentation in Medicine IX, SPIE 273, 52-56 (International Society for Optical Engineering, Bellingham, WA, 1981).

Information transfer in a screen-film system occurs over a limited region of x-ray exposures because of the nonlinear response of film to light emitted from the x-ray fluorescent screen. The information transfer efficiency of a typical screen-film system is determined as a function of x-ray exposure for different x-ray energies. The method of determining this transfer efficiency is described, and the x-ray exposure regions over

which information transfer can occur with this system is delineated for different x-ray energies.

120. Nadeau, F.; Fick, S.; Rosen, M.; Horowitz, E., Magnetostrictively-driven ultrasonic device for sound velocity measurements in thin ribbons, Report CMR-NDE-3 (Johns Hopkins Univ., Baltimore, Nov. 1981).

121. Norton, S. J.; Linzer, M., Ultrasonic reflectivity imaging in three dimensions: exact inverse scattering solutions for plane, cylindrical, and spherical apertures, IEEE Trans. Biomed. Engrg. BME-28, No. 2, 202-220 (Feb. 1981).

The problem of reconstructing the reflectivity of a three-dimensional medium with density and compressibility variations is examined. Exact solutions are obtained for the general case of arbitrary broad-band insonification where the incident wave is assumed to be a spherically diverging pulse of arbitrary shape. Under most practical conditions, the process of back projection and coherent summation over spherical surfaces in image space is shown to provide a close approximation to the exact inversion procedure. Finally, the equivalence between the three-dimensional inverse Radon transform and the far-field approximation is demonstrated.

122. Parker, W. L.; Garrett, D. A., Comparison of non-reactor-based neutron radiographic facilities, NBS Reactor: Summary of Activities July 1979 to June 1980, NBS TN-1142, 34-39 (May 1981).

Three operating neutron radiographic facilities of different types, which do not use a reactor, were visited and compared. Radiographs were taken of various test objects and quality indicators.

123. Parker, W. L.; Garrett, D. A., Measurement of the L/D ratio, NBS Reactor Summary of Activities July 1979 to June 1980, NBS TN-1142, 40-45 (May 1981).

Earlier work, which assumed that the neutron source was linear, has been extended by means of a theoretical treatment of the images to be expected when the source is circular.

124. Parker, W. L.; Garrett, D. A., Resolution of a radiographic facility, NBS Reactor: Summary of Activities July 1979 to June 1980, NBS TN-1142, 46-49 (May 1981).

125. Payne, B. F. Absolute calibration of back-to-back accelerometers, Instrumentation in the Aerospace Industry 27, 483-488 (Instrument Society of America, Research Triangle Park, NC, 1981).

Back-to-back accelerometers are widely used as vibration standards. Some problems exist in accurate calibration of these accelerometers due to the effects of mass loading on the sensitivity. A new method is presented here which describes a standard, absolute, interferometric calibration method using a dummy load. This method makes possible

direct displacement measurements at the top mounting surface of the accelerometer under a loaded condition. In this paper experimental data are presented and compared for some typical back-to-back accelerometers.

126. Placious, R. C.; Garrett, D. A.; Kasen, M. B.; Berger, H. Dimensioning flaws in pipeline girth welds by radiographic methods, Mater. Eval. 39, 755-759 (July 1981).

Methods for field radiographic inspection of pipeline girth welds are reviewed with an eye toward the need for obtaining accurate defect dimensional information from the radiographs. This requirement for defect dimensions will demand increased attention to record keeping and radiographic variables such as x-ray energy, film type and screens, film processing and source location. However, attention to these variables can lead to a reduction in repeat radiographs and potential cost savings.

127. Porter, G., Getting more for less -- improving productivity in metals processing, Dimensions/NBS 65, No. 5, 2-9 (July 1981).

Designing new alloys or processing methods is not the only way to improve the productivity and quality of metals manufacturing. Significant savings in energy and improvements in quality can be made by better control of manufacturing methods already in use. Increased use of ultrasonic inspection methods throughout the processing cycle offers one potential means to this end.

128. Prask, H. J.; Choi, C. S.; Singhal, S., Small-angle neutron scattering study of a two-phase tungsten alloy, NBS Reactor: Summary of Activities July 1979 to June 1980, NBS TN-1142, 116-117 (May 1981).

Preliminary SANS measurements have been made in three tungsten-alloy "kinetic-energy" penetrators.

129. Proctor, T.; Eitzen, D. G., NBS point displacement sensor, A Review of Advanced Acoustic Emission Sensors, NADC-81087-60, D. K. Lemon, ed., appendix E, 11 p. (Naval Air Development Center, Philadelphia, April 1981).

130. Quate, C. F., Innovative measurements technology for the semiconductor device industry -- "The acoustic microscope -- a new instrument for viewing integrated circuits", NBS-GCR-80-204. 1980 May. 6p. Available from: NTIS; $5.00.

The operating frequency of scanning acoustic microscopes has been increased with a resulting improvement in resolution approximating that of the best optical microscopy. An instrument operating in the reflection mode was developed. The mechanisms by which contrast is produced in the acoustic microscope have been explained and verified. The instrument reveals different information about the specimen than other kinds of microscopy, because it responds to variations in the density and elastic properties of the specimen.

131. Ramboz, J. D. Measurement and evaluation methods for an angular accelerometer. NBSIR 81-2237. 1981 August. 75 p. Available from: NTIS; PB 82-115973.

A transducer which measures angular acceleration along one axis was investigated to assess three of its performance characteristics, viz., sensitivity factor, amplitude linearity, and response to linear (non-angular) input accelerations. Test philosophy and methodology are discussed along with measurement results.

132. Reed, R. P. Goal: Better standards for pipeline welds, Weld. Des. Fabr. 54, No. 8, 68-71 (Sept. 1981).

The NBS program to assist the Department of Transportation in establishing fitness-for-service alternative allowable flaw size standards is reviewed.

133. Richmond, J. C. Errors in passive infrared imaging systems due to reflected ambient flux, SPIE Infrared Imaging Syst. Technol. Proc. 226, 110-114 (1980).

Passive infrared imaging systems produce a signal in which the amplitude at a particular spot is related to the radiance of the corresponding spot in the scene viewed. The differences in signal levels in different areas of the image may be converted to true radiance temperatures if the scene includes an object whose radiance temperature is known. The radiance temperatures are usually converted to true temperatures by correcting for the emittance of objects in the scene. This would be correct in the absence of reflected ambient flux. However, for scenes at ambient temperatures, ambient flux is always present in significant amounts. Temperature errors due to reflected ambient flux are discussed from a theoretical standpoint, and a procedure for experimentally evaluating the ambient flux is suggested.

134. Rosen, M.; Fick, S.; Horowitz, E., An ultrasonic investigation of precipitation hardening phenomena in 2219 aluminum alloy, Report CMR-NDE-1 (Johns Hopkins Univ., Baltimore, March 1981).

See abstract for No. 135.

135. Rosen, M.; Horowitz, E., Fick, S.; Mehrabian, R., Dynamic monitoring of the precipitation process in 2219 aluminum alloy by means of sound velocity and attenuation measurements, 1981 Ultrasonic Symp. Proc., Vol. 2, 945-947 (IEEE, Piscataway, NJ, 1981).

The precipitation hardening process in 2219 aluminum alloy has been investigated by means of dynamic measurements of sound velocity, ultrasonic attenuation and hardness. Measurements of these properties as a function of aging time were found to exhibit variations related to the formation of precipitates responsible for the hardening process. The present investigation has demonstrated the feasibility of a real-time dynamic NDE method for monitoring precipitation hardening over a wide temperature interval.

136. Rosen, M.; Fick, S.; Friant, C. L.; Horowitz, E., Nondestructive characterization of the precipitation hardness process in aluminum alloys, Report CMR-NDE-2 (Johns Hopkins Univ., Baltimore, Sept. 1981).

The properties and precipitation hardening processes in 2024 Al alloy were investigated using NDE techniques.

137. Rosen, M.; Fick, S.; Horowitz, E., Correlation of ultrasonic data with hardness after aging 2024 aluminum alloy under T4, T351, and T851 conditions, Report CMR-NDE-4 (Johns Hopkins Univ., Baltimore, Nov. 1981).

138. Ruthberg, S. Graphical solution for the back pressurization method of hermetic test, IEEE Trans. Components, Hybrids, Manuf. Technol. CHMT-4, No. 2, 217-224 (June 1981).

A new graphical procedure is presented for complete solution of the molecular flow equation through the use of a single set of characteristic curves and a test line. The effects of repetitive testing and of prefill with tracer gas are also considered. The characteristic curves are appropriate for both the helium leak detector and the radioisotope methods of test, while the form of the test line distinguishes between the two methods.

139. Sato, T.; Norton, S. J.; Linzer, M.; Ikeda, O.; Hirama, M., Tomographic image reconstruction from limited projections using iterative revisions in image and transform spaces, Applied Optics 20, 395-399 (Feb. 1981).

An iterative technique is proposed for improving the quality of reconstructions from projections when the number of projections is small or the angular range of projections is limited. The technique consists of transforming repeatedly between image and transform spaces and applying a priori object information at each iteration. Computer simulations show how the process of forcing the image to conform to a priori object data reduced artifacts arising from limited data.

140. Sato, T.; Linzer, M.; Ikeda, O.; Hirama, M., Ultrasonic imaging through turbulent media using data selection processing, J. Acoust. Soc. Am. 70, 756-762 (Sept. 1981).

The concept of data selection during image formation is proposed to enhance ultrasonic images obtained by focusing through turbulent media. In this approach, a focused transducer array is used in transmit to concentrate the ultrasonic energy at a desired point in the object, and the reflected waves are detected by the array elements and focused through appropriate delay operations. Data selection is carried out by comparing the complex amplitudes of the delayed signals. Only the data which satisfy suitable criteria are used in synthesizing the image.

141. Sawyer, D. E.; Kessler, H. K.; Russell, T. J.; Lankford, W. F.; Schafft, H. A. Measurement techniques for solar cells, Annual Report: December 15, 1978 to December 14, 1979. NBSIR 80-2181. 1981 January. 60 p. Available from: NTIS; PB 81-163875, $8.00.

The NBS-developed laser scanner was used to examine a variety of cells. The results show that it is possible to detect areas of missing antireflection coating, lack of ohmic contact of the metallization to the cell, breaks in cell metallization fingers, fine cracks, scratches, and silicon carbide inclusions. A solar cell test pattern is described and the results of cell sheet resistance measurements are discussed. The test pattern includes four solar cells (three with internal defects). Modifications to the laser scanner system are described including an improved reflected-light detection system, a birefringence capability, and a new light source for biasing large-diameter cells.

142. Sawyer, D. Nondestructive method for detecting defects in photodetector and solar cell devices. U. S. Patent 4,287,473. 1 September 1981. 8p.

The invention described herein is a method for locating semiconductor device defects and for measuring the internal resistance of such devices by making use of the intrinsic distributed resistance nature of the devices. The method provides for forward-biasing a solar cell or other device while scanning with an optical spot. The forward-biasing is achieved with either an illuminator light source or an external current source.

143. Schafft, H. A.; Ruthberg, S.; Cohen, E. C. eds. Semiconductor measurement technology: ARPA/NBS workshop V. Moisture measurement technology for hermetic semiconductor devices. Nat. Bur. Stand. (U. S.) Spec. Publ. 400-69; 1981 May. 202 p. SN003-003-02326-4, $6.00.

The workshop served as a forum to examine present problems with the measurement of moisture in hermetic semiconductor devices. Manuscripts and summaries are provided of 19 talks, panel meetings, and group encounters on three major topics: mass spectrometer measurements of internal package moisture, moisture sensors, and package analysis and quality assurance.

144. Schrack, R. A.; Behrens, J. W.; Johnson, R.; Bowman, C.D. Resonance neutron radiography using an electron Linac, IEEE Trans. Nucl. Sci. NS-28, No. 2, 1640-1643 (Apr. 1981).

The NBS electron LINAC is being used to implement a resonance neutron radiography system. Position-sensitive proportional counters indicate location and time of arrival of neutrons transmitted through the material being radiographed. Measurements have been made using silver, tungsten, gold, and the uranium isotopes. One-dimensional position-sensitive detectors have been used to image objects from 1 cm to 13 cm in diameter. Two-dimensional position-sensitive detectors are now being developed to provide more rapid and accurate data accumulation. A folded wire proportional counter has been designed and built in collaboration with Oak Ridge National Laboratories. Measurements indicate a resolution on the order of 1 mm. A detector using a multichannel plate image amplifier is being built to use a lithium glass disk for neutron detection. The ability of resonance neutron radiography to provide both assay and image of a specific isotope in a sample provides great advantages over conventional NDA and imaging systems.

145. Shawker, T. H.; Morgan, B.; Linzer, M.; Parks, S.I.; James, S. P.; Stromeyer, F. W.; Barranger, J. A., B-scan echo-amplitude measurement in patients with diffuse infiltrative liver disease, J.Clin. Ultrasound 9, 293-301 (Aug. 1981).

146. Shives, T. R.; Willard, W. A., eds. Detection, diagnosis and prognosis: Contribution to the energy challenge. Nat. Bur. Stand. (U. S.) Spec. Publ. 622; 1981 October. 329 p. SN003-003-02361-2.

These proceedings consist of 21 submitted entries from the 32d meeting of the Mechanical Failures Prevention Group. Areas of special emphasis included techniques for failure detection in energy related systems, improved prognosis techniques for energy related systems, and opportunities for detection, diagnosis and prognosis in the energy field.

147. Shorten, F. J., ed. NBS reactor: Summary of activities July 1979 to June 1980. Nat. Bur. Stand. (U. S.) Tech. Note 1142; 1981 May. 211 p. SN003-003-02314-1, $6.00.

The programs range from the use of neutron beams to study the structure of materials through neutron standards, neutron radiography, and nondestructive evaluation.

148. Siegwarth, J. D. Ratio frequency liquid level gauging in propane tank car safety tests - A feasibility study. NBSIR 79-1600. 1979 January. 15.p. Available from: NTIS; PB 292978, $3.00.

Selected radio frequency resonances of an empty tank car have been measured to determine whether rf can be used to gauge the propane liquid levels during tank car fire safety tests. The technique is applicable to routine tank car gauging.

149. Simmons, J. A.; Clough, R. B. Theory of acoustic emission, Dislocation Modelling of Physical Systems, J. Hirth and M. Ashby, eds., pp. 464-497 (Pergamon Press, Oxford, England, 1981).

A theory of acoustic emission is presented based on a Green's function type of formalism, rather than on the conventional count rate concept. Sources are represented by stress drop tensors and conditions from which the source can be considered small in terms of wavelength and distance to the transducer. These sources are examined over a restricted frequency bandwidth. Such a system may be described by a tensor transfer function type of formalism, facilitating the analysis and reducing the inverse problem to a deconvolution operation. Due to the tensor nature of the source, multiple transducer measurements are necessary to reconstruct the source stress drop.

150. Simmons, J. A.; Clough, R. B. Theory of acoustic emission, Proc. DARPA/AFWAL Rev. of Progress in Quantitative NDE, La Jolla, CA, 1980, AFWAL-TR-81-4080, 239-240 (Sept. 1981).

See abstract for No. 149.

151. Singhal, S. P.; Alperin, H. A.; Herman, H.; Biancaniello, F., Small-angle neutron scattering study of the microstructural development during precipitation strengthening of Ni based superalloys, NBS Reactor: Summary of Activities July 1979 to June 1980, NBS TN-1142, 118-123 (May 1981).

A program has been started to study the kinetics of precipitation strengthening and subsequent microstructural changes during the creep and high temperature fatigue deformation of nickel-based superalloys for aircraft engine turbine blades.

152. Sjolin, L.; Wlodawer, A. Improved technique for peak integration for crystallographic data collected with position-sensitive detectors: A dynamic mask procedure, Acta. Cryst. A37, 594-604 (1981).

A technique for improving the precision of crystal data collected on films or with electronic position-sensitive detectors is proposed. The method was applied to data collected with X-ray precession and oscillation techniques and to neutron data collected with a flat-cone diffractometer equipped with a linear detector. In all cases substantial improvement in the precision of weaker reflections was observed. The overall quality of the data was particularly enhanced in the neutron diffraction case.

153. Smith, C., Fracture mechanics research aims at lowering construction costs, Dimensions/NBS 65, No. 7, 14 (Sept. 1981).

One of the world's largest testing machines is being used at NBS to pull apart large plates of steel. The work is part of a program to come up with a method for specifying the maximum allowable size of flaws in base metal and in welds for each kind of material and each class of structural member.

154. Smith, J. H., Federal safety regulations based on fracture mechanics -- application and present status, 1981 Paper Summaries, ASNT National Conferences, 200-201 (ASNT, Columbus, OH, 1981).

An assessment of the current potential for basing Federal safety regulations on fracture mechanics suggests that expanded use of fracture mechanics must be coupled with reliable and well accepted nondestructive evaluation methods.

155. Snyder, R. L.; Hubbard, C. R.; Panagiotopoulos, N. C., Auto: a real time diffractometer control system. NBSIR 81-2229. 1981 Feb. 102 p. Available from: NTIS.

This system controls two powder diffractometers mounted on the same x-ray generator simultaneously. The computer provides the user with the ability to perform all conventional diffraction analyses.

156. Swartzendruber, L. J.; Boettinger, W. J. ; Ives, L.K.; Coriell, S. R.; Mehrabian, R., Relationship between process variables, microstructure and NDE of a precipitation-hardened aluminum alloy, Nondestructive Evaluation: Microstructural Characterization and Reliability Strategies, O. Buck and S. M. Wolf, eds., 253-271 (AIME, N. Y., 1981).

The relationship between process variables used during casting, working, and heat treatment of 2219 aluminum alloy and the resulting microstructures, mechanical properties, and NDE responses were investigated. A comprehensive series of c-curves was determined to relate hardness, tensile strength, yield strength and conductivity after aging to various degrees of improper quench from solution heat treatment temperature. These c-curves established a correlation between mechanical properties and electrical conductivity.

157. Swyt, D. A.; Jensen, S. W., Measurements of small dimensions of products and by-products, Optics in Metrology and Quality Assurance, Proc. SPIE, Vol. 220, 28-35 (Soc. Photo-Optical Instrumentation Engrs., Bellingham, WA, Feb. 1980).

Direct-imaging and plane-projection instruments are mainstays for definitive calibration quality measurements of small dimensions for industrial applications. Substantial systematic errors in dimensional measurements occur in industrial applications from particle sizing to photomask metrology. The causes of such difficulties and the techniques to overcome them are discussed in the context of work on the development of SEM and optical techniques.

158. Taylor, L. S. X-ray measurements and protections 1913-1964: The role of the National Bureau of Standards and the National Radiological Organizations. Nat. Bur. Stand. (U. S.) Spec. Publ. 625; 1981 December. 386 p. SN003-003-02375-2.

Chapter 14, pages 253-259, provides interesting historical information on standardization efforts relating to radiography from 1934 to 1939.

159. Teague, E. C.; Vorburger, T. V.; Maystre, D. Light scattering from manufactured surfaces, Ann. CIRP 30, No. 2, 1-7 (Dec. 1981).

We present an evaluation of light scattering theories and experimental techniques for measuring the roughness of manufactured surfaces.

160. Treado, S. J. Measuring roof system thermal resistance, Proc. 6th Conf. Roofing Technology, Gaithersburg, Md., 1981, 50-57.

This measurement technique utilizes a combination of infrared thermographic imaging, surface heat-flow meters and surface thermopiles. The thermal resistance of the roof system is computed from temperature difference across the roof and the measured heat flow through the roof.

161. Vest, C. M., Holographic NDE: Status and future. NBS-GCR-81-318. 1981 May. 76 p. Available from: NTIS; PB 81-207409, $9.50.

This is the final report of a research program whose objective was to examine the current role and future potential of optical holographic interferometry for nondestructive evaluation of materials and components. Our approach has been to attempt to delineate both technical and industrial criteria which must be met by industrially-viable NDE techniques, and then to render estimates of whether holographic NDE can meet these criteria. The technical literature was thoroughly reviewed in order to assess the current status of holographic NDE.

162. Vorburger, T. V.; Ludema, K. C., Ellipsometry of rough surfaces, Applied Optics 19, No. 4, 561-573 (Feb. 15, 1980).

Ellipsometry measurements on several different kinds of rough surfaces were compared with stylus measurements of the surface texture. The results are discussed along with the prospects for using ellipsometry as a tool for measuring surface roughness.

163. Vorburger, T. V.; Teague, E. C., Optical techniques for on-line measurement of surface topography, Precision Engineering 3, 61-83 (1981).

An extensive literature search was carried out on experimental optical techniques for measuring surface roughness. State-of-the-art techniques are reviewed, including specular reflectance, total integrated scatter, diffuseness, angular scattering distributions, speckle, ellipsometry, and interferometry.

164. Webber, S., NBS inventors are honored -- eight receive I-R 100 awards Dimensions/NBS 65, No. 7, 5-9 (Sept. 1981).

The winners include Charles Tilford, Peter Heydemann, Donald Martin, Richard Hyland, and Frederick Long, who jointly developed an ultrasonic interferometer manometer which extends the present range of liquid column manometry by a factor of 100; and Thomas Proctor who developed an improved acoustic emission transducer that can be used to upgrade the measurement capabilities of industrial acoustic emission instruments, and as a flaw detector for in-service quality control of manufactured products.

165. White, G. S.; Feldman, A. Diffraction from a shallow rectangular groove, Appl. Opt. 20, No. 14, 2585-2589 (July 15, 1981).

Infrared radiation scattered from a shallow groove is found to exhibit the same diffraction pattern as a single slit. A model based on a beam with a Gaussian intensity profile was found which explains the observed scattering patterns and which also describes the scattering pattern occuring when certain alignment errors are present in the system. The large scattering intensity from the shallow groove has implications in the use of optical scattering as a tool for NDE of surface flaws.

166. Wilson, R. G.; Weglein, R. D., Reflection acoustic microscope measurement technology. NBS-GCR-81-363. 1981 December. 9 p. Available from: NTIS; PB 82-165168, $5.00.

A scanning acoustic microscope was developed for the inspection of semiconductor devices and integrated circuits. This instrument provides a new analysis technique that is sensitive to material properties, namely, the mass density and elastic stiffness. With the acoustic microscope, it is possible to display some subsurface features that cannot be seen using optical or scanning electron microscopes. Fctors that change the local density of materials, such as temperature or strain, also may affect the acoustic velocity and impedance and therefore the acoustic image.

167. Yin, L. I; Trombka, J. I.; Seltzer, S. M. Three-dimensional imaging of x-ray and gamma-ray objects in real time, Applied Optics 19, 2952-2956 (Sept. 1980).

A simple device is described that is capable of providing real-time 3-D viewing of extended X-ray and gamma-ray objects. The visible-light images produced by the device possess both horizontal and vertical parallax with a reasonably large field of view.

168. Yonemura, G. T. Criteria for recommending lighting levels. NBSIR 81-2231. 1981 March. 60 p. Available from: NTIS; PB 81-185126, $8.00.

Lighting standards and recommendations for general applications should be based on the visibility (seeing) requirements where differences between individuals are minimal. Furthermore, lighting criteria or standards must evaluate the seeing process under stimulus conditions approximating those encountered in the real space. It is recommended that conspicuity, defined as: "how well the detail stands out from the backgound," or ease of seeing be the metric for visibility. Subjective visual response criteria cannot be universally applied where significant differences in intrepretations and evaluations between individuals and/or groups of individuals occur.

169. Yonemura, G. T. Visual acuity testing of radiographic inspectors in nondestructive inspection. Nat. Bur. Stand. (U. S.) Tech. Note 1143; 1981 June. 29 p. SN003-003-02330-2, $2.50.

Visual acuity tests for radiographic inspectors should be correlated with the type of tasks encountered in real world radiography. The testing procedures should be capable of assessing differences in day to day performance of a given inspector as well as the performance of one inspector relative to other inspectors. Single line targets with specific parametric values for contrast, width, and blur are recommended to provide a means for testing a radiographic inspector for visual acuity.

170. Yoo, K. C.; Roessler, B.; Armstrong, R. W.; Kuriyama, M. Reflection X-ray topography of hardness indentations in copper single crystals, Scr. Met. 15, 1245-1250 (1981).

The plastic deformation zones surrounding microhardness indentations have been studied by the asymmetrical crystal topography method. The method gives valuable information about the importance of workhardening to determining the level of the microhardness pressure and the magnitude of its anisotropy for different directions of the indenter axes.

171. Younglove, B. A.; McCarty, R. D. Speed-of-sound measurements for nitrogen gas at temperatures from 80 to 350 K and pressures to 1.5 MPa, J. Chem. Thermodyn. 12, No. 12, 1121-1128 (1980).

172. Younglove, B. A. Velocity of sound in liquid propane, J. Res. Nat. Bur. Stand. (U. S.). 86(2): 165-170; 1981 March-April.

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☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

This is the fifth in a series of bibliographies of NBS publications on nondestructive evaluation (NDE). It provides bibliographic citations, with selected abstracts, for 172 publications that appeared in the open literature, primarily during calendar year 1981. A detailed subject index is included as well as information on how copies of many of the publications may be obtained.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

abstracts; acoustic emission; bibliography; eddy currents; index; leak testing; magnetic testing; National Bureau of Standards; nondestructive evaluation; publications; radiography; ultrasonics

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