Nondestructive Characterization For Composite Materials Aerospace Engineering Civil Infrastructure And Homeland Security 2010

Proceedings of SPIE offer access to the latest innovations in research and technology and are among the most cited references in patent literature.

The papers published in these peer-reviewed proceedings represent the latest developments in nondestructive characterization of materials and were presented at the Tenth International Symposium on Nondestructive Characterization of Materials held on June 26 - 30, 2000 in Karuizawa, Japan. The symposium was held concurrently with three other symposia and one workshop. This symposium is the tenth in the series that began in 1983 and became an international meeting in 1986. The symposium started with a Plenary Lecture entitled 'Application of Non-contact Ultrasonics to Nondestrctive Characterization of Materials' by Professor R.E. Green, Jr. Various characterization methods were presented at the symposium, including ultrasonics, X-ray, eddy currents, laser, thermal wave, acoustic emission, optical fibers, optics, magnetics and ultrasonic microscope. Thin films and coatings as well as smart materials were also emphasized in this symposium.

A guide to NDE of composite materials by acoustic wave propagation, including advanced ultrasound methods, for detailed identification and measurement of defects, and characterization of microstructure and properties. "The major objective is to present the basic concepts of wave propagation in anisotropic media, and to show how these concepts can be applied to the quantitative, nondestructive evaluation of composite media."

There is a great deal of interest in extending nondestructive technologies beyond the location and identification of cracks and voids. Specifically there is growing interest in the application of nondestructive evaluation (NOEl to the measurement of physical and mechanical properties of materials. The measurement of materials properties is often referred to as materials characterization; thus nondestructive techniques applied to characterization become nondestructive characterization (NDCl. There are a number of meetings, proceedings and journals focused upon nondestructive technologies and the detection and identification of cracks and voids. However, the series of symposia, of which these proceedings represent the fourth, are the only meetings uniquely focused upon nondestructive characterization. Moreover, these symposia are especially concerned with stimulating communication between the materials, mechanical and manufacturing engineer and the NDE technology oriented engineer and scientist. These symposia recognize that it is the welding of these areas of expertise that is necessary for practical development and application of NDC technology to measurements of components for in service life time and sensor technology for intelligent processing of materials. These proceedings are from the fourth international symposia and are edited by c.o. Ruud, J. F. Bussiere and R.E. Green, Jr. . The dates, places, etc of the symposia held to date area as follows: Symposia on Nondestructive Methods for TITLE: Material Property Determination DATES: April 6-8, 1983 PLACE: Hershey, PA, USA CHAIRPERSONS: C.O. Ruud and R.E. Green, Jr.

Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil

Infrastructure, and Homeland Security 2008Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 20117-10 March 2011, San Diego, California, United States; [the Conference ... Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security was Held at the 2011 SPIE Smart Structures/NDE Symposium].Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2012

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Different physical models for the Snoek-type relaxation in ternary systems (Fe-C-Me) are analyzed from the viewpoint of a distance of interatomic interaction taken into account: For non-saturated from the viewpoint of overlapping of interatomic interaction in b.c.c. alloys the physically sufficient and optimal for the computer simulation is the short-range model, which takes into account the interatomic interaction and the average amount of substitutional atoms in the first coordination shell, only. For high alloyed b.c.c. systems (i.e. with the overlapped interatomic interaction) the carbon atom undergoes an interaction of a few substitutional atoms simultaneously. That leads to the appearance of one broadened Snoek peak. Activation energy of such a peak is summed from the "elastic" and "chemical" interatomic interactions. Experimental results for alloys with b.c.c. solid solution structure and its computer simulations allow to introduce the new criterion for the high alloy state of monophase steels: the high alloyed state corresponds to the situation when substitutional atoms can not be considered any longer as the isolated atoms. From the viewpoint of mechanical spectroscopy this situation corresponds to the appearance of one broadened IF Snoek-type peak instead of two peaks existed for the steels with lower substitutional atom concentration.

In this era of technological progress and given the need for welfare and safety, everything that is manufactured and maintained must comply with such needs. We would all like to live in a safe house that will not collapse on us. We would all like to walk on a safe road and never see a chasm open in front of us. We would all like to cross a bridge and reach the other side safely. We all would like to feel safe and secure when taking a plane, ship, train, or using any equipment. All this may be possible with the adoption of adequate manufacturing processes, with non-destructive inspection of final parts and monitoring during the in-service life of components. Above all, maintenance should be imperative. This requires effective non-destructive testing techniques and procedures. This Special Issue is a collection of some of the latest research in these areas, aiming to highlight new ideas and ways to deal with challenging issues worldwide. Different types of materials and structures are considered, different non-destructive testing techniques are employed with new approaches for data treatment proposed as well as numerical simulations. This can serve as food for thought for the community involved in the inspection of materials and structures as well as condition monitoring.

This paper is based upon introductory remarks presented at the opening of the ASTM Symposium on Damage in Composite Materials. The cooperation between specialists in fatigue and in nondestructive testing, in the organization and implementation of the symposium, is marked as a noteworthy milestone in an era in which closer cooperation between these two groups will be needed in order to achieve enhanced quality in materials and manufactured products.

The development and implementation of advanced composite material systems and their associated technologies are critical for success in the highly competitive world aerospace market. Acceptance of advance production methods and field support of structures made with these new materials require the development of quantitative, cost-effective, inspection methods. The results of quantitative ultrasonic through-transmission imaging of composites with complex three-dimensional architecture using phase-insensitive and phase-sensitive techniques are presented. Miller, James G. Unspecified Center NSG-1601

The role of non-destructive evaluation is changing dramatically, and it has already expanded beyond its historical mission of detecting macroscopic defects in structures and in finished components which had usually spent a considerable time in service. Quality control methods are insufficient for assuring defect-free composite materials, which are manufactured at the time of part fabrication. Nondestructive evaluation (NDE) techniques appear, potentially, to offer a means of identifying such defects. The techniques of ultrasonic C-scanning, X-ray radiography, vibrother-mography, and acoustic emission monitoring are considered here. The materials of interest are E-glass and S-2 glass reinforced sheet molding compound. Results from ultrasonic C-scans clearly indicate areas of imperfections. Results of the vibrother-mography and acoustic emission monitoring, however, suggest the need for additional work in these areas, while those of X-ray radiography are inconclusive.

The papers published in these proceedings represent the latest developments in Nondestructive Characterization of Materials and were presented at the Eleventh International Symposium on Nondestructive Characterization of Materials held in June 24-28, 2002 in Berlin, Germany.

The possibility of nondestructively characterizing the microstruc ture, morphology or mechanical properties of materials is certainly a fascinating subject. In principle, such techniques can be used at all stages of a material's life - from the early stages of processing, to the end of a structural component's useful life. Interest in the subject thus arises not only from a purely scientific point of view but is also strongly motivated by economic pressures to improve productivity and quality in manufacturing, to insure the reliability and extend the life of existing structures. The present volume represents the edited papers presented at the Second International Symposium on the Nondestructive Characterization of Materials, held in Montreal, Canada, July 21-23, 1986. The Proceedings are divided into eight sections, which reflect the multidisciplinary nature of characterizing materials nondestructively: Polymers and Composites, Ceramics and Powder Metallurgy, Metals, Layered Structures/Adhesive Bonds/Welding, Degradation/Aging, Texture/ Anisotropy, Stress, and New Techniques. Invited papers by R. Hadcock of Grumman Aircraft Systems, R. Cannon of Rutgers University, H. Yada of Nippon Steel and R. Bridenbaugh of Alcoa review respectively the processing of polymer matrix composites, ceramics, steel and aluminum, emphasizing the need for material property sensors to improve process and quality control. Two other invited papers, one by A. Wedgwood of Harwell and the other by P. Holler of the IzFP in Saarbrucken review state of the art techniques to characterize particulate matter and metals respectively.

With national trade barriers falling, causing the expansion of the com petitive global market, the question of quality control has become an essential issue for the 1990s. The time where the promise was to replace a product if it does not work seems to have passed; what is more impor tant now is not so much a reduction in what is going wrong but an increase of what is going right the first time (Feigenbaum 1990). This new trend is sometimes referred to as total quality. Among the many advantages ofthis zero-defect manufacturing policy, we can enumerate (Laurin 1990): superior marketability of wholly de pendable products, enormous gain in productivity, elimination of waste ful cost in replacing poor quality work and retrofitting rejected products from the field. Although total quality is a relatively new and attractive concept for mass products such as cars, consumer electronics and per sonal computers, in many fields, mainly aerospace and military, it has been the rule for years because of security reasons.

This book is a printed edition of the Special Issue "Intelligent Sensing Technologies for Nondestructive Evaluation" that was published in Sensors

Traditionally the vast majority of materials characterization techniques have been destructive, e. g. , chemical compositional analysis, metallographic determination of microstructure, tensile test measurement of mechanical properties, etc. Also, traditionally, nondestructive techniques have been used almost exclusively for the detection of macroscopic defects, mostly cracks, in structures and devices which have already been constructed and have already been in service for an extended period of time. Following these conventional nondestructive tests, it has been common practice to use somewhat arbitrary accept-reject criteria to decide whether or not the structure or device should be removed from service. The present unfavorable status of a large segment of industry, coupled with the desire to keep structures in service well past their original design life, dramatically show that our traditional approaches must be drastically modified if we are to be able to meet future needs. The role of nondestructive characterization of materials is changing and will continue to change dramatically. It has become increasingly evident that it is both practical and cost effective to expand the role of nondestructive evaluation to include all aspects of materials' production and application and to introduce it much earlier in the manufacturing cycle. In fact, the recovery of a large portion of industry from severe economic problems is dependent, in part, on the successful implementation of this expanded role.

A test run was performed on IM6/3501-6 carbon-epoxy in which the material was processed, machined into specimens, and tested for damage tolerance capabilities. Nondestructive test data played a major role in this element of composite characterization. A time chart was produced showing the time the composite material spent within each Branch or Division in order to identify those areas which produce a long turnaround time. Instrumented drop weight testing was performed on the specimens with nondestructive evaluation being performed before and after the impacts. Destructive testing in the form of cross-sectional photomicrography and compression-after-impact testing were used. Results show that the processing and machining steps needed to be performed more rapidly if data on composite material is to be collected within a reasonable timeframe. The results of the damage tolerance testing showed that IM6/3501-6 is a brittle material that is very susceptible to impact damage. Nettles, A. T. and Tucker, D. S. and Patterson, W. J. and Franklin, S. W. and Gordon, G. H. and Hart, L. and Hodge, A. J. and Lance, D. G. and Russel, S. S. Marshall Space Flight Center ...

Ultrasonic methods have been very popular in nondestructive testing and characterization of materials. This book deals with both industrial ultrasound and medical ultrasound. The advantages of ultrasound include flexibility, low cost, in-line operation, and providing data in both signal and image formats for further analysis. The book devotes 11 chapters to ultrasonic methods. However, ultrasonic methods can be much less effective with some applications. So the book also has 14 chapters catering to other or advanced methods for nondestructive testing or material characterization. Topics like structural health monitoring, Terahertz methods, X-ray and thermography methods are presented. Besides different sensors for nondestructive testing, the book places much emphasis on signal/image processing and pattern recognition of the signals acquired.

The Strategic Defense Initiative Organization has place d a great deal of emphasis on the development on new composite materials, specifically metal and ceramic matrix composites. These types of composite materials offer the advantages of being lighter, stiffer, stronger, and more resistant to creep and corrosion. However, because of physical and chemical differences of the matrix and reinforcing agents the interface is plagued by chemical reactions and a high level of residual stress. This impedes the ability of the interface to bear and transfer load and results in fracture upon subsequent loading. Thus, the need for nondestructive characterization of interfaces is critical to the development of these high technology composite materials. Feedback from a nondestructive interface characterization technique is also critical to the further development and refinement of the materials processing procedures. The goal of the Johns Hopkins University program was to study these characteristics and develop techniques which utilize interface waves for nondestructive evaluation of composite interfaces. This final report summarizes the results of two projects which examined the use of interface waves for nondestructive evaluation of composite interfaces. The first project focused on Stoneley waves and their sensitivity to interfacial bond quality and microstructural changes. The second project focused on the use of leaky waves for the nondestructive characterization of interfaces. Featured sessions presented in this symposium include: (1) Magnetic Techniques; (2) Non-Metallic Materials; (3) Stress Measurement; (4) X-ray Applications; (5) Optical Techniques Including Laser; (6) Ultrasound; (7) Thermal Techniques; (8) Acoustic Emission and Internal Friction; (9) Composite Materials; (10) Process Control; (11) Particle Technology; and (12) Ultrasonics Applications. (MM).

Engineering structures for reliable function and safety have to be designed such that operational mechanical loads are compensated for by stresses in the components bearable by the materials used. Vhat is "bearable"? First of all it depends on the properties of the chosen materials as well as on several other parameters, e.g. temperature, corrosivity of the environment, elapsed or remaining serviceable life, unexpected deterioration of materials, whatever the source and nature of such deterioration may be: defects, loss of strength, embrittlement, wastage, etc. DEFECTS and PROPERTIES of materials currently determine loadability. Therefore in addition to nondestructive testing for defects there is also a need for nondestructive testing of properties. The third type of information to be supplied by nondestructive measurement pertains to STRESS STATES under OPERATIONAL LOADS, i.e. LOAD-INDUCED plus RESIDUAL

STRESSES. Residual stresses normally cannot be calculated; they have to be measured nondestructively; well-approved elastomechanical finite element codes are available and used for calculating load-induced stresses; for redundancy and reliability, engineers, however, need procedures and instrumentation for experimental checks.

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