Overview

This symposium was organized for the purpose of documenting theoretical and experimental techniques that are used for predicting, analyzing or measuring dynamic elastic moduli in solid materials.

The volume is comprised of fifteen papers which cover the spectrum of pertinent aspects from fundamental research to technological application. The invited overview paper by Berry illustrates the power of precise elastic modulus measurements in understanding the influence of microstructural defects at the atomic level on the mechanical properties of materials, including the new superconductors with high critical temperatures. The other fourteen papers address various aspects of elastic modulus measurements, predictions and analyses. Examples of experimental data from high frequency (MHz) measurements are presented by Kinra and Dayal, and Blessing, and from low frequency (< 1 kHz) measurements by Wren and Kinra. The influence of temperature on dynamic elastic modulus is documented in the papers by Cook, Wolfenden and Ludtka, and Lemmens. Measurements and analyses of dynamic elastic moduli in composite materials are covered in the contributions by Heyliger, Ledbetter and Austin, Wolla and Wolfenden, and Datta and Ledbetter. The theory and modeling of elastic constants are studied in the papers by Ledbetter, and Datta and Ledbetter. Elegant technological use of dynamic elastic modulus measurements is displayed in the papers on crack monitoring by Carpenter, on bonded joints by Dickstein, Sinclair, Spelt, Segal, and Segal, and on cemented soils by Lovelady and Picornell. A comparison of three measurement techniques (including the well-known static technique) is presented by Wyrick, Poole, and Smith for mechanically alloyed materials. The use of computer interfacing for data processing of dynamic elastic modulus results forms the basis of the paper by Fowler. Lemmens shows in his paper that measurements can be made as rapidly as one per second. The volume has some details of the varied instrumentation necessary for dynamic elastic modulus measurements and the papers are well referenced.

This volume offers guidance in the selection of appropriate methods of measuring dynamic elastic modulus where temperature, frequency and strain amplitude are of concern. It will be useful to materials scientists and engineers who are concerned with fundamental or practical aspects of dynamic elastic contants, including the effects of cracks. Some papers in the volume will be of interest to NDE and QC practitioners.

Many existing (and future) problems in engineering and science are connected with the precise determination of dynamic elastic modulus. This book is therefore relevant in areas such as load-deflection, thermoelastic stresses, buckling, elastic instability, creep, fracture mechanics, interatomic potentials, thermodynamic equations of state, lattice defects and free energy. Knowledge of the dynamic elastic modulus of materials is of prime importance in the design of high-speed turbines and components for the planned hypersonic vehicles.

As a major conclusion from this group of contributors. it can be seen that measurements of dynamic elastic modulus (and its complex counterpart damping) will provide both fundamental and technological information on the elastic (and anelastic) behaviour of solid materials. The measurements are particularly useful if they are carried out under the appropriate service conditions of frequency, temperature and strain amplitude. Although a wide range of frequencies (typically 50 Hz to 15 MHz), temperatures (approximately 78 to 1800 K) and strain amplitudes (10^{-8} to 10^{-4}) has been explored by the authors in this volume, there are obvious gaps remaining for future research.

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