University. He has been active in the Reactor Operations Division of the American Nuclear Society, where he recently completed a term as chairman of the Division. He has authored or co-authored over 40 publications concerned with radiation detection and reactor operations.

Treatise on Materials Science and Technology: Plastic Deformation of Materials—Volume 6

Editor	R. J. Arsenault
Publisher	Academic Press, Inc.
Date	May 1975
Pages	504
Price	$45.00
Reviewer	Louis J. Demer

Plastic deformation is a very important and fertile branch of materials science. This book reviews some of the great profusion of ideas on plastic deformation that have been put forward over the years. The seven chapters, written by experts in their fields, describe the mechanisms of plastic deformation of metals, crystalline nonmetals, and polymers in the temperature range from near absolute zero to the melting temperature of the material in question. The goal was to analyze the important developments in each area and to place them in a modern perspective. The concept of dislocations is used to account for the low observed levels of stress needed to achieve permanent deformation. This enables discussion of the development of theories of dislocation dynamics and the testing of these theories against observed stress-strain curves for a large variety of crystalline materials. The book contains more than 1000 references.

The low-temperature deformation of body-centered cubic (bcc) metals and their solid solution alloys is the subject of the first chapter written by R. J. Arsenault. Their behaviors are unusual when compared to face-centered cubic (fcc) metals and their alloys that have been extensively dealt with in other reviews. Significant recent findings in the usually treated areas of low-temperature plastic deformation of metals are expertly considered in extensive detail. Arsenault also treats the effects of radiation damage and the superconducting state of bcc materials. Not considered are the topics of twinning, fracture, and grain-size effects. Curiously, an error in the title appears both in the Table of Contents and in the heading of the chapter, namely, "Low Temperature *of* Deformation of bcc Metals . . . ."

In the second chapter, Campbell Laird reviews the cyclic deformation of metals and alloys. He does not attempt a comprehensive treatment in so limited a space, but reviews on a selective basis, drawing from only a few papers in areas of general agreement but citing many more studies where controversies exist, where problems still remain to be solved, or where the phenomena are so complicated that more detailed treatment is appropriate. An attempt is made to illustrate explicitly both the value of cyclic stress-strain response data for fatigue design and the value of microstructural studies in cyclic stress-strain response.

The present understanding of high-temperature creep is reviewed by Amiya K. Mukherjee. He considers the present status of experimental knowledge on the high-temperature diffusion-controlled creep of some metals and alloys with particular reference to the various creep mechanisms. The work is presented in three major sections. The first is concerned with the effects of the independent variables of stress and temperature on the creep rate, and the possible influence of crystal structure, modulus of elasticity, stacking fault energy, and grain size on these data. Second, emphasis is given to a review of the major substructural changes that attend high-temperature creep. Third, a summary is presented on the theoretical implications of the known experimental facts relative to the validity of various proposed high-temperature creep mechanisms. No attempt is made to cover all aspects of creep literature. Instead, attention is directed toward areas where a reasonable understanding has been achieved in uncovering the underlying mechanisms of creep, thereby leading to a satisfactory correlation between the experimental data and theoretical predictions. A number of different diffusion-controlled mechanisms are known to determine high-temperature creep rates, and each is influenced in its own unique way by substructural and microstructural modifications. It is concluded that because of the highly structure-sensitive nature of creep processes, electron microscopy coupled with additional tools of examination will be essential and invaluable aids in unraveling this complex subject.

Review topics in superplasticity are treated by Thomas H. Alden. He doesn't attempt to review the many well-known achievements in this area that have received much attention in the last decade. Instead, a discussion is presented of some subjects previously neglected. Results are presented from several unpublished studies, and an attempt is made to provide a new synthesis of published data that may further clarify the phenomenology and mechanism of superplasticity. Among topics discussed are techniques of grain refinement, grain growth, alloy-specific properties, creep behavior, and the effect of temperature on the strain rate sensitivity. An attempt is made also to evaluate our understanding of these phenomena. Alden's summary makes it clear that although much is known about the superplasticity phenomenon, there are still some mechanisms that remain to be satisfactorily explained.

Broadening the material treatment, P. Beardmore and S. Rabinowitz discuss the current state of understanding of the fatigue deformation of polymers. In a well-presented review it is established that the development of detailed deformation mechanisms in polymers generally is still in its infancy. Most studies so far have been macroscopic and phenomenological in nature. The account of the relatively few sophisticated fatigue studies thus far carried out on polymers indicates that cyclic deformation can contribute to the development of understanding of basic deformation mechanisms and therefore should be conducted concurrently with the more standard types of deformation studies. It is noted that the usefulness of fatigue studies of polymers is greatly enhanced by concurrent examination of both phenomenological and mechanistic properties.

The low-temperature deformation of crystalline nonmetals is reviewed by R. G. Wolfson. The materials treated are those inorganic nonmetals that can deform by crystallographic slip in the vicinity of room temperature. After a general discussion of semibrittle behavior, the specific behaviors of ionic crystals and covalent crystals are treated in extensive detail. The review closes with a treatment of methods showing promise for the suppression of brittle fracture. The more than 270 references attest to the comprehensive character of this review.

In the last offering in the volume, H. J. McQueen and J. J. Jonas treat the recovery and recrystallization of metals during high-temperature deformation. This article considers the microstructural changes occurring both during and after hot working. It describes the influences of these changes on the mechanical properties of the worked material. The effects of strain hardening and its counterbalancing by the concurrent softening processes of dynamic recovery and dynamic recrystallization are examined in detail for metals deformed under both hot working and creep conditions. The treatment is expert, comprehensive, and detailed.

The book assumes that the reader has a basic understanding of dislocation theory. It will aid in focusing on the pressing current and future problems encountered in plastic deformation. It should be of great interest to metallurgists, ceramists, polymer chemists, graduate students in materials science and associated fields, and nuclear engineers concerned with plastic deformation.

Treatise on Materials Science and Technology: Microstructures of Irradiated Materials—Volume 7

Author	H. S. Rosenbaum
Publisher	Academic Press, Inc.
Date	July 1975
Pages	173
Price	$19.50
Reviewer	Louis J. Demer

Microstructural information on the effects of irradiation on solids is often vital to the solution of materials problems associated with nuclear energy technology. A basic approach is to observe and characterize microstructures, to rationalize these microstructures in terms of atomic rearrangement phenomena, and then to relate the microstructures to materials properties. This monograph aims at the development of an appreciation of the diverse and complex microstructures encountered in irradiated materials along with a practical understanding of the response of materials to irradiation environments.

A broad interpretation is given to the term irradiation effects so that it encompasses all manifestations of irradiation environments that lead to atomic rearrangements and therefore to observable microstructural changes. Numerous illustrations present various microstructures as examined using optical microscopy, field ion microscopy, and both scanning and transmission electron microscopy.

The author introduces broad concepts and terminology initially and then proceeds to consider the physical effects of irradiation, that is, those associated with the physical displacement of atoms and the subsequent atom rearrangements that can occur either by momentum transfer or diffusional phenomena. The chemical effects of irradiation are also treated, including diffusion, phase changes, precipitation of solute atoms, transmutations, and combinations of these.

The treatment proceeds from simple materials such as pure metals irradiated under isothermal conditions at low temperatures to the case of materials with complex microstructures. Where possible the complex structures are explained as a superposition of known physical and chemical effects. In some instances, however, two or more irradiation effects interact to produce a resultant microstructure different from that expected by simple superposition. These synergistic effects of irradiation on microstructures exist in many aspects of this subject, but the details are so complex that our knowledge remains sketchy.

The monograph contains some 325 references, a large portion of which are quite recent. It includes a review of the relevant literature, presented with sufficient background that readers familiar with general metallurgical phenomena can use this book directly as an introduction to the effects of irradiation without having to consult references. It should be very useful to metallurgists, ceramists, materials scientists, and engineers in nuclear science and technology. It will also be useful for those contemplating entering the nuclear field. The relatively unsophisticated treatment should make it suitable for students of materials science or engineering at an advanced undergraduate or early graduate level.

L. J. Demer, professor of metallurgical engineering at the University of Arizona, has a broad background in mechanical metallurgy, x-ray analytical methods, and imperfections in crystals. He has published in the areas of fatigue, crack growth and detection, and environmental effects on mechanical properties. He has performed research in the nondestructive evaluation of materials by novel ultrasonic techniques. Demer has also explored the use of multiple-image audiovisual techniques in the presentation of materials science and engineering course material. He is currently engaged in intensive research involving electronic materials defect characterization by x-ray and electron microscope techniques.

Nuclear Tracks in Solids (Principles and Applications)

Authors	Robert L. Fleischer, P. Buford Price, and Robert M. Walker
Publishers	University of California Press
Date	October 16, 1975
Price	$31.50
Pages	629
Reviewer	J. A. Lockwood

The technique of utilizing the radiation-damage tracks produced by the passage of charged particles through certain nonconducting solids is now sufficiently advanced, as the authors indicate, to warrant a comprehensive overview. The authors have succeeded in this book in presenting a clearly and carefully written survey of particle track etching