Book Reviews

New Image of Metal Physics

Progress in Materials Science. vol. 9, parts 1–5. Bruce Chalmers, Ed. Pergamon, New York, 1961. ix + 389 pp. Illus. (parts 1–5 are also available as paperbound separates). $20.

Most scientists and engineers find themselves forced into narrowing avenues of specialization by the information explosion that accompanies the rapid advance of science and technology. Contrary to the trend toward specialization, the emergent discipline of materials science is the result of synthesis rather than fragmentation. Materials science is developing from metallurgy, solid state physics, ceramics, physical chemistry, and other fields that share a common interest in the structure and properties of materials. The movement toward a unified science of materials is evidenced by changes in the organization of materials research groups, in university curricula, and in the technical literature devoted to materials.

The first volume of this series was *Progress in Metal Physics*, published in 1949. The stated purpose of the series was to present up-to-date reviews of specialized aspects of physical metallurgy and metal physics. The editors have achieved this aim, and they have performed an excellent service for their readers by a wise selection of topics and contributing authors. The individual articles have always been well done, and some have been truly distinguished.

This volume, the ninth in the series, is the first to carry the new title, *Progress in Materials Science*. The change in title and Bruce Chalmers's statement of changing editorial policy are further indications of the broadening range of interest of those active in the field of materials. Future volumes are expected to contain reviews of topics concerning the whole range of the science of materials. Apart from the new title, this volume represents no departure in subject matter or in treatment from the preceding volumes. However, future volumes can be expected to deviate somewhat from the previous pattern.

The first review article is T. J. Rowland's "Nuclear Magnetic Resonance in Metals." When a solid or liquid sample of material is placed in a uniform magnetic field and a weak, high-frequency oscillating field is superimposed upon this field, resonance effects occur. When the frequency of the oscillating field equals the Larmor precessional frequency of the nuclei of the specimen atoms, energy is absorbed. This form of absorption spectroscopy, nuclear magnetic resonance, has proved to be particularly valuable in the study of the electronic environment of atoms. The author presents a clear, concise review of the principles involved, discusses some of the limitations, and describes a few examples of the application of nuclear magnetic resonance to the study of metals. The technique has been used in the study of atomic ordering, diffusion, point defects, dislocations, and precipitation.

"The Effect of Temperature and Alloying Additions on the Deformation of Metal Crystals," by R. W. K. Honeycombe, is a review of the plastic behavior of single crystals of metals and alloys. The influence of crystal structure, alloy content, impurities, and temperature are described and a brief summary of theories of work hardening is included. No attempt is made to review the transmission microscopy studies that have recently brought much new information to light.

"Effects of Environment on Mechanical Properties of Metals," by T. R. Kramer and L. J. Demer, describes the plastic behavior of metals under more complex experimental conditions. For many years it has been recognized that the yield stress and flow stress of metals can be strongly influenced by the surrounding material that is in contact with the metal surface. Many observations of such effects have been made but without the explanations being well established. The most acceptable explanations suggest the formation or removal of adherent surface films which either block dislocations at the surface, resulting in pile-ups, or else lock surface dislocation sources.

"The Hydrogen Embrittlement of Metals," by P. Cotterill, is an ambitious review and analysis of a large body of information about hydrogen in metals, some of it clearly established and some of it rather speculative. The introductory discussion considers the absorption, solution, and diffusion of hydrogen in metals. This is followed by detailed descriptions of the influence of hydrogen on the mechanical properties of a variety of metals and alloys. Hydrogen is infamous as a detrimental impurity in many metals because it promotes brittle fracture. Although Cotterill summarizes with "a general theory of hydrogen embrittlement in metals," I doubt that the fragmentary information available about this complex subject warrants generalization.

The fifth and last article is "The Structure and Properties of Solid Solutions," by J. M. Sivertsen and M. E. Nicholson. The electron theory of metals resulted from attempts to explain the crystal structure and solubility ranges of alloy phases in terms of the electronic structure of the alloys and the concept of the Brillouin zone. More recently, the theory has proved increasingly useful in explaining the properties of alloy phases. The authors review the thermal, electrical, magnetic, and mechanical properties of solid solutions where these can be related to their electronic structure. This includes some interesting discussion of lattice defects.

This ninth volume of the series is the first to be published in two forms: as a hard-cover edition and as separate paperbound copies of the individual articles. The total price of the five separately bound monographs equals that of the hard-cover volume. This form of publication should expedite the publishing of future articles. One unfortunate result may be that some future articles will not be widely read, since it will no longer be necessary to purchase an entire volume to obtain articles of most immediate interest.

JOHN SHYNE
Department of Materials Science, Stanford University