Book Reviews

Superconductors, Metals, Polymers, Electronics ...

Introduction to the Modern Theory of Metals. By *Alan Cottrell.* The Institute of Metals, London 1988. 260 pp., hard cover, $ 73.50, ISBN 0-904357-97-X

My first book review, written in Chicago in 1955, was on *Cottrell's* "Theoretical Structural Metallurgy". At that time I was impressed by the non-physical argumentation which *Cottrell* used in that small book for the explanation of metallurgical phenomena, and it is a method I have often made use of during my career in physical metallurgy. Now, 35 years and many book reviews later, I have the opportunity to review the latest offering from *Cottrell,* another review of the basics of the metal state which attempts to incorporate the modern theories of today's metallurgists.

The book is intended to bring the post-war work of *Hume-Rothery* and *Raynor* up to date, work which *Cottrell* experienced at first hand during a stint as Professor in Birmingham from 1949 to 1955. Since that time he has worked at Harwell and at Cambridge, been a government science advisor, and Master of a college and Vice-Chancellor at the University of Cambridge. Here, during his retirement, he writes refreshingly on the electron theory of metals and alloys as if the intervening years had had no effect whatsoever. Truly a fascinating personality and performance!

The 10 chapters and 13 appendices (which make up more than one third of the book and contain the necessary mathematics) discuss the following points:

1. What is the definition of a metal? (Includes a discussion of the insulator-metal transition and electron delocalization).
2. Why are electrons 'free' (based on shielding and pseudopotentials)?
3. What is the effect of electron correlation?
4. What are the effects of band structure?
5. The cohesion in simple metals and the energies of lattice defects.
6. The d-shell transition metals and their magnetism.
7. The problems with Cu, Ag, and Au with respect to the Hume-Rothery rules for alloys.
8. The surface of metals.
9. Superconductors, including the high-T_c variety.

The physics of every example is explained well, the mathematical proofs being restricted to a minimum or confined to discussion in an appendix. The presentation makes the work highly readable, complete but concise. The metallurgist with some background in physics, or the physical chemist will gain much from reading the book. It is a masterpiece which provides an important education in the basic science that is applicable to many areas of materials science.

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Studies of High Temperature Superconductors. Volume 1. Edited by *Anant Narlikar.* Nova Science Publishers, New York, 1989. xiv, 381 pp., bound, $ 85.—ISBN 0-941743-44-3

The discovery of superconductivity in a La-Ba-Cu-O compound by *Bednorz* and *Müller* triggered a world wide race in the search for new superconducting materials with still higher transition temperatures. At the same time an enormous wave of publications was set in motion that continues today without any sign of diminishing. In order to ensure rapid publication, new journals mushroomed overnight everywhere, and it was extremely difficult to keep track of important developments.

Presently, three years after the beginning of high-T_c fever, the first books summarizing the current state of the art in the field are being published. The book in hand is the first volume of a series entitled *Studies of High Temperature Superconductors—Advances in Research and Applications,* edited by *Anant Narlikar* from the National Physical Laboratory in New Dehli, India. The underlying motivation for this series is the need for a convenient access to important advances in the field not only for scientists and engineers, but also for graduate students of physics, chemistry, materials science and related fields. Hence most of the chapters in each of the volumes have the character of a review article focusing on theoretical and experimental aspects of research in the field.

Volume one of this series contains 15 chapters, seven of which discuss theoretical approaches to high-T_c superconductivity. The remaining chapters summarize the processing of bulk and thin film materials, microstructural effects, elastic properties, and X-ray photon spectroscopy (XPS). *C. N. R. Rao* from the Indian Institute of Science gives an overview of the oxygen hole mechanism of superconductivity, including a review of available Auger and XPS data. *S. S. Jha* from the Tata Institute of Fundamental Research in Bombay reviews the generalized BCS pairing at the weak as well as the strong coupling limit, including a modified theory for layered crystals. A discussion of possible pairing mechanisms in high-T_c superconductors concludes this article.