siderable amount of work done in the last twenty years on the theory of chemical bonding in molecules, both quantitatively and qualitatively. Solid-state and molecular physicists definitely have a lot to learn from each other.

The last two chapters deal with localized states associated with point defects and surfaces, and disordered materials.

A number of the many topics left out of the presentation are mentioned and the reader is referred to a fairly complete bibliography. Ten pages of problems are provided, without answers. For some of the more advanced problems references to books or journal articles are given.

Madelung's stimulating introduction to solid-state theory is definitely recommended both to newcomers in the field and to those who perhaps are well acquainted with parts of the field but who would like to know more about other sides and to connect that with what they know already.

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Solid Surface Physics. Springer Tracts in Modern Physics. Vol. 85. Edited by G. HÖHLER, with contributions by J. HÖLZL, F. K. SCHULTE and H. WAGNER. Pp. vii + 221. Berlin, Heidelberg, New York: Springer, 1979. Price DM 68·00, *ca* US $37.40.

Volume 85 of this series on solid-state physics consists of two substantial surveys. The first (by J. Hölzl and F. K. Schulte) is devoted to the modern state of studies of the electron work function (WF) of metals, which is an important parameter of the electron structure of metallic surfaces. In the second (by H. Wagner) a number of physical and chemical properties of the real surface are described on the basis of the stepped-surface model.

Review 1. Rapid progress, both theoretical and experimental, has taken place in WF studies during the past thirty years as a consequence of new experimental surface methods, ultra-high vacuum techniques and industrial interest (especially in catalysis and electronics).

This survey differs from previous ones in the breadth of its contents and by its concentration of interest on the most recent advances. The theoretical problems are considered in chapter 2, after a brief introduction (chapter 1). The density function formalism, in which electrons are viewed as an interacting gas in the field caused by the ion cores, is used for calculations of the WF. Also the self-consistent wave-mechanical model and some other methods of WF calculations are described.

WF values are tabulated and compared with some new experimental data. The agreement is close in most cases, though sometimes serious deviations occur (Li, Au). The changes of the WF that are caused by adsorbates on the surface of pure metals and alloys are discussed in detail, but the problems of polycrystalline metal surfaces and of the thermodynamics of electron emission are not considered.

The third chapter is devoted to experimental procedures. Methods of WF measurement are divided into two groups: absolute methods (thermionic emission, photoemission, field emission) and relative ones (diode methods, condenser methods). The peculiarities of the various types of measurement are discussed very carefully.

Experimental results of WF measurements from pure metals with clean surfaces, together with a brief summary of various theoretical models, are given in chapter 4, and an analytical comparison is carried out. Moreover, variations of the WF with temperature, and the mechanical stress dependence of the WF are considered, and data connected with phase transitions are discussed. WF values are tabulated for nearly all metals.

The fifth chapter is devoted to the WF variations caused by adsorption on clean metals. WF data are used to determine parameters of the adsorbates. Results are given for a large number of adsorbate systems.

WF measurements in binary alloys are described in chapter 6. Some useful recommendations on preparative procedures are given. WF data as a function of certain alloy parameters are discussed and, as an example, WF measurements are used to obtain a thin alloy film diffusion coefficient and its temperature dependence.

On the whole, this fundamental work, containing more than 500 references, will be useful for specialists in the physics and chemistry of solids, thin films and adjacent fields.

Review 2. This review is devoted to studies of periodic stepped surfaces. The crystallographic description of regular steps and experimental facts confirming the reality of steps are given in chapters 1 and 2. Electron microscopy and, especially, low-energy electron diffraction techniques are discussed as the most effective methods for the study of stepped surfaces.

Properties of the clean stepped surface are presented in chapter 3. The thermal stability of steps and the transitions between stepped and 'hill and valley' structures are considered on the basis of the model of temperature-dependent small free-energy differences of both states. Also in this chapter, theoretical calculations and measurements of the WF are given for stepped surfaces. The WF and surface state density are shown to depend upon the step character, and for semiconductors new steps occur in some cases.

The interaction of stepped surfaces with foreign atoms or molecules is discussed in the fourth chapter. The main attention is paid to adsorption kinetics and reaction processes, owing to their technological importance in heterogeneous catalysis, epitaxy, and corrosion. The concept of 'active sites' in heterogeneous catalysis is considered to set up the connection between catalytic properties and special surface states. The steps and the kinks are high coordination places, and they can be especially active during 'structure active' reactions. Though most of the experimental facts are only qualitatively interpreted the differences in physical properties and kinetic processes related to a given low index plane and the corresponding stepped surface are distinctly shown.

To understand the physical reasons responsible for the many phenomena associated with steps, it is necessary to have additional experimental facts and more systematic

studies; nevertheless, the present review is very valuable for specialists in solid-state physics and chemistry and also for crystallographers interested in surface crystallography.

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Handbook on the physics and chemistry of the rare earths, Vol. 1: Metals. Edited by K. A. GSCHNEIDER JR and L. EYRING. Pp. xxv + 894. Amsterdam: North-Holland, 1978. Price US $146.25, Dfl 300.00.

This volume is the first of four which, together, will provide a complete survey of the properties of the rare-earth pure metals, alloys and compounds. There has been a considerable research programme on these materials over the last twenty years and it is certainly timely that a comprehensive review should now be produced. The title on the cover of the present volume offers the reader a Handbook but the expectant investigator, seeking a well ordered, tabulated set of data, will be disappointed. Instead, a series of attractive review articles will be found, written by acknowledged experts in the field, generally at a level which should be very acceptable both to postgraduate students and to a wide variety of research workers in the different disciplines of the physical sciences.

This first volume concentrates on the properties of the rare-earth elements although, inevitably, there are references to alloys and compounds. It begins with an article on atomic properties (the free atom) which is somewhat forbidding in the depth of the theoretical treatment and the extent of the mathematical formulae. This is also the longest article in the book. Most readers will leave this chapter for the experts and glance only occasionally at the tabulated data. The rest of the book is less mathematical and easier reading for the non-specialist in the field. There are articles on the purification and crystal growing of rare-earth metals, electronic band structure, low-temperature heat capacity (specific heat), magnetic and electrical porperties, high-pressure effects and superconductivity. A separate article is devoted to cerium and two rather specialized chapters deal with the Kondo effect and diffusion topics. Each article has a very useful up-to-date bibliography.

This is hardly a book which research workers in general will consider purchasing for individual use. It is too long (almost 900 pages) to be acceptable as an introductory survey, which can be read in its entirety by physicists, chemists or metallurgists considering whether the rare-earth metals have features relevant to their own chosen fields of endeavour. Moreover, there is no logical and coherent development of the subject matter such as is to be found in the books by Taylor & Darby (1972) and by Coqblin (1977). Nor is it a book in which the enquiring student will easily discover the value for some particular quantity. Many of the significant numerical results are hidden in the text and the index is not as helpful as might be expected. Thus under the index heading 'Debye Temperature: terbium' the reference given is to pages 401, 407, where indeed values of θ_D may be found by careful perusal of the text. In fact, the Debye temperature will be found more clearly displayed in tables on pages 389 and 680. The index heading 'data for magnetic transitions' directs the reader to pages 734–738, with no cross reference to the tables on pages 415 and 515. There are, presumably, values for the critical fields which define the boundaries for the helical phases of the rare earths, but my own search of the volume has not yet revealed these. Equally frustrating are the inappropriate page titles for chapter 9, *Metals, alloys and compounds*; the article is in fact concerned with high pressure studies. However, despite these irritating defects, research workers from a variety of fields (say, for example, crystal growing, laser technology, superconductivity, magnetism, neutron scattering, electron microscopy, metallurgy) will find some interesting and useful review articles in this volume. Sadly, there seems little quantitative work reported in this book which might be of direct concern to the crystallographer.

The present volume appears to be something of an evangelical exercise and may be very helpful in bringing properties of the rare-earth metals to the attention of a wide range of physical scientists. It is more definitely oriented towards the general reader than was the outstanding earlier review edited by Elliott (1972), and will be a worthwhile addition to the departmental library.

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Physics of superconductors (Topics in current physics, Vol. 15). Edited by M. B. SALAMON. Pp. xii + 255. Berlin, Heidelberg, New York: Springer-Verlag, 1979. Price DM 59·00, *ca* US $32.50.

This volume comes as a sequel to the recent publication concerned with the same field, under the title of '*Solid Electrolytes*', issued in the series '*Topics in Applied Physics*'. For those who enjoyed that descriptive approach [a review was published in *Acta Cryst.* (1978), A**34**, 640], this new volume, specifically on the physics of these materials, offers some more meaty theory on a wide range of currently developing aspects. EXAFS, neutron scattering, lattice dynamics, light scattering, magnetic resonance, phase tran-