Short Notices

Mechanical properties of bone

F. Gaynor Evans

Charles C. Thomas, Springfield, Illinois, 1973. 336 pp. US $25.75

Very occasionally, a new book is published which gives coherence and form to an area of research. For example, in the metallurgical field, the appearance of Cottrell's first elegant text on dislocations stimulated many advances in this topic during the succeeding decade. Professor Gaynor Evans' new book on the *Mechanical properties of bone* comes within this concept of a definitive book. The author's credentials are impeccable. He is Professor of Anatomy at the University of Michigan and has been engaged in research in this area for more than twenty years. His book brings together a wide range of research on the deformation and fracture of bone and, as such, provides an excellent starting point for the materials scientist wishing to enter this area; not least because some of the exotic medical-biological references are beyond the capabilities of many libraries. The first chapter on basic mechanics, together with much of chapter two on test methods will be well known to the Materials Scientist. But chapter three on *in vivo* versus *in vitro* testing, chapter four on drying effects, chapter five on preservation techniques and chapter six on temperature effects, illustrate the biological sophistication and control required for effective physical measurements. Then follows a significant chapter (seven) on directional differences, which highlights the anisotropic properties of bone and from which the concept of bone as a natural composite can be drawn. The intriguing effects of duration, frequency and rate of loading are considered in chapter eight, while a brief discussion of the viscoelastic and plastic properties of bone is presented in chapter eleven. The effects of structure, at various levels, and of biological variables such as age and species are presented in chapters nine, ten and thirteen. Finally, some special effects, i.e. reduced forces, radioactive isotopes and piezo electricity, are considered in chapter twelve.

In general, this well-produced book contains the two components of "properties" and "structure" which are familiar to the materials scientist. It does not contain the third component, namely "the correlation of properties with structure", which awaits further advances in understanding. Consequently, again for "metallurgical readers", the parallel is perhaps to be made with the classic plasticity text of Schmid and Boas. Certainly, as a book which focuses attention on the intrinsic properties of bone, in contrast to the current flurry of activity on materials for its replacement, it is a timely and welcome addition to the literature.

W.B.

Glass Science

R. H. Doremus

John Wiley, New York, 1973. 349 pp. £9·00

The author's aim is to provide a text suitable for a wide spectrum of readers including students and those undertaking research. This has necessitated the inclusion of relatively elementary treatments of some subject areas but in others, speculative explanations for experimental findings are offered as stimuli for further research. The author largely succeeds in combining these somewhat divergent approaches to provide a useful contribution to the literature on glass.

The first of the five sections, into which the book is divided, discusses the formation and structure of glass in terms of atomic arrangements, amorphous phase separation, crystal nucleation and growth processes. The second section on transport properties links together viscosity and the glass transition and also includes a comprehensive treatment of molecular diffusion in glasses. Properties depending on ionic motion such as electrical conductivity, dielectric losses and mechanical losses are discussed in detail and an outline is given of the behaviour of electronically conducting glasses. In the section on chemical and surface properties there are useful chapters dealing with adsorption processes, reactions with gases and aqueous solutions and glass electrodes. The section on mechanical strength develops the topic from basic ideas to a discussion of recent researches on static fatigue effects. In the final section, optical absorption effects in glasses are briefly outlined, though other optical properties are excluded. A valuable feature of the book is that extensive bibliographies are included for the various subject areas.

In general, the book can be regarded as a worthwhile addition to the materials scientist's library but students may find the rather high price a deterrent to individual purchase.

P.W.M.

Annual Review of Materials Science, Volume 2

Edited by *R. A. Huggins*, assisted by an Editorial Committee.

Annual Reviews Inc., Palo Alto, California, 1972. 778 pp. $10.00 postpaid ($10.50 outside the USA)

This first addition to a series covering many sciences will, by the time this review appears, have been followed by the third volume and the fourth will be on its way. It contains 22 concise reviews ranging from 24 to 58 pages, on a variety of classes of materials, structural features and experimental methods, by authors in the USA, Britain, the Netherlands and the Soviet Union. Some deal with topics rarely reviewed, such as Kane and Larrabee's admirable survey of physical methods of analysing trace elements in solids, or Ernsberger's on glass surfaces; others deal with familiar topics, sometimes reviewed by the "standard authors", such as Hale and Kelly on fibre-composites, Doremus on structure of glasses or Peterlin on mechanical properties of polymeric solids. A polymath, Sato, surveys film growth, and immediately following this survey of high-vacuum delicacy, Pugh reports on the use of hydrostatic fluid pressure to work recalcitrant metals.

The above list covers only a few of the entries, each with a substantial list of references attached. The volume includes very substantial author and subject indices and a cumulative list of contributions to the first two volumes. Reprints of individual chapters can be purchased for $1.00 each. This concession, together with the price of $10.00, makes this volume the most remarkable value for money in scientific publishing that I have encountered in years. This is one of those few series to which everyone in materials science should seriously consider subscribing.

R.W.C.

Ion Implantation

G. Dearnaley, J. H. Freeman, R. S. Nelson and *S. Stephen*

North-Holland, Amsterdam, 1973. 802 pp. Dutch florins 225, US $79

The volume under review is the eighth, and most substantial, in the North-Holland series on *Defects in Crystalline Solids*. The authors all work at the Atomic Energy Research Establishment at Harwell, where ion implantation was first studied as an aspect of radiation damage and then, when diversification became the order of the day, other practical aspects of the technique, notably ion implantation in semiconductors, were energetically attacked. The combination of expertise in solid state physics, accelerator technology and solid state electronics led to a highly effective symbiosis, and the names of the Harwell workers, entirely justifiably, frequently appear in the pages of this volume.

Dearnaley writes on the basic factors which govern ion range in solids, with very special reference to the "channelling" of ions along favoured lattice directions. He concludes by discussing anomalous diffusion entailed by entrained vacancies and by showing how channelling is used as a diagnostic tool to locate solute aoms. Nelson next examines the state of a solid damaged by ion implantation: he also discusses at length the subsequent behaviour of implanted ions.

Freeman deals in great technical detail with accelerators and ion sources, and Stephen devotes over 200 pages to the methods, advantages and consequential problems of implanting electrically active ions in silicon and germanium. In connection with *most* devices, to which ion implantation has principally been applied up to now, the relative merits of this method are compared with those of thermal diffusion. This chapter is a major account of its subject.

The last short chapter outlines other applications of ion implantation, for instance to modify the refractive index of glass surfaces (to make light guides), to produce wear-resistant metal surfaces, or to implant emitter ions for Mössbauer spectroscopy.

This book will be a standard text in its field.

R.W.C.