ionized aggregates of a few hundred to a few thousand atoms rather than individual atoms or molecules. These clusters are formed by the condensation of evaporated atoms during adiabatic expansion through a narrow aperture into a high vacuum region. They are then ionized by electron impact and uniformly accelerated in an electric field between source and substrate surface. A single charge on the cluster is thus used to accelerate many hundreds of atoms. A cluster consisting of 500 atoms has a diameter of the order of 30 Å. The size, charge, and acceleration voltage of the clusters are intimately related with the film formation process.

The author of this book is considered to be the pioneer of the ionized-cluster beam technique. He started the research in this field at Kyoto University (Japan) in 1972. The various activities of the author to promote the spreading of this method throughout the world largely determine also the character of this book. In 60 of the 100 references *T. Takagi* is one of the authors. This unbalanced selection of the material implies that a critical comparison of the ionized-cluster beam deposition with both conventional evaporation and sputter deposition as well as low-energy ion deposition is unfortunately not given. Throughout the entire text the author emphasizes the advantages of "his" technique. In the case of crystalline semiconducting materials, like e.g. Si or GaAs, this point of view is totally misleading, because the quality of thin films prepared by ionized-cluster deposition is far inferior to that of films prepared by either chemical vapor deposition or by molecular beam epitaxy. Unfortunately, most aspects of ionized-cluster beam deposition discussed in this book are treated only qualitatively. A number of misprints and errors should be eliminated in a following edition.

Due to the partiality and the lack of an in-depth treatment of the subject this book is of limited use only. It can, however, serve as an introduction to the field.

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Mathematical Approach to Glass. By *M. B. Volf.* Elsevier Science Publishers, Amsterdam 1988. 420 pp., bound, DFL 275. – ISBN 0-444-98951-X

There are different approaches to glass science and technology. One approach is based on chemistry and attempts to answer the question of how the properties of a glass change after the substitution of one component by another. A second approach investigates the structure of the glasses and tries to set up structural models. Of course, structure and properties are related to each other. Glass formation, on the other hand, may also be related to thermodynamic and kinetic arguments, both being of equal importance.

In this book the chemical approach to glass is stressed. The text is essentially based on the finding that the properties of glass are roughly determined by the properties of the constituent atoms or ions and by their bonds. Projected into calculations, this in most cases makes it possible to predict in what way an element will behave when bound to oxygen in an oxide glass. Optimization of properties may then also be possible in a given type of glass. Thanks to the rapid introduction of computer technology ranging from pocket calculators to large computers, the field of applied mathematics in glass is expanding.

The book contains four main chapters. In the first, general ideas and models are described, e.g. models on the chemistry and technology of glass, the chemical model as a theoretical base for the calculations in the chemistry of glass, questions of composition and composition factors, characteristics of mass and volume, activation energy for describing temperature dependencies, and questions of acidobasicity.

The second chapter deals with the affinity of properties, that means, how one property is related to another property. This interdependence of properties is, of course, essential for the approach described in this book.

The third main chapter, on the dependence of properties on composition, contains the known and developed methods, e.g. additivity principles, the methods of *Winkelmann* and *Schott, Gehlhoff* and *Thomas, Huggins* and *Sun, Appen, Gan Fu-Xi, Demkina, Mackenzie* et al., and some regressive and statistical schedules.

The fourth main chapter is the most comprehensive one and discusses the physical dependence of properties. The properties investigated are density, optical properties, permittivity, thermal properties, elasticity, strength, hardness, photoelasticity constant, thermal expansion coefficient, resistance to thermal shock, surface tension, viscosity, electrical properties, and chemical durability. Some supplements and a list of references conclude the book.

This book is of importance to people working in the glass industry and who want to know how a property changes with the change of a component. In most cases the absolute value is not necessary. However, the tendency of the change is more important. This book, of course, has also some value to people who are not so familiar with glasses and their properties and who want to get a feeling of how chemistry influences glass properties. However, there are many anomalously behaving glasses, e.g. borate-containing or mixed alkali glasses. In those cases possible differences between prediction and measurements have to be checked.

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Encyclopedia of Materials Science and Engineering, Supplementary Volume 1. Edited by *R. W. Cahn,* Senior advisory Ed. *M. B. Bever.* Pergamon Press, Oxford 1988. xiii, 653 pp., hardcover, US $ 295.—ISBN 0-08-032551-1.

The Encyclopedia of Materials Science and Engineering, published in the spring of 1986, is a comprehensive reference work and source of information for a wide readership, including but not restricted to practitioners in the broad domain of materials. It consists of eight volumes containing 1580 articles, the production of which involved almost 1500 experts all over the world. The Encyclopedia has been well received by reviewers and has been acquired by institutions worldwide.

It is clear that change in some areas is so rapid that publication must be a continuing activity if the Encyclopedia is to retain its position as an authoritative and up to date systematic compilation of our knowledge and understanding of materials. This is the prime objective of the Supplementary Volumes of the Encyclopedia of Materials Science and Engineering, of which this is the first. The Supplementary Volumes are designed to be used in conjunction with the Main Encyclopedia.

Supplementary Volume 1 contains 113 articles which fall into three categories; articles covering new materials, processing and characterization techniques, models and interpretations, all discovered or developed after the spring of 1985 when the main encyclopedia went to press; articles covering mature topics which for a variety of reasons were not treated in the main encyclopedia; and articles designed to bring the treatment of topics already covered in the main encyclopedia up to date. The later articles are divided into two subsidiary categories.

a) Supplementary articles which are intended to be read in conjunction with the original article of the same, or similar, title in the main encyclopedia; generally a subsidiary phrase such as "recent developments" has been added to the title.

b) Replacement articles which are intended to substitute entirely for the original article and therefore have the title of that article. These articles generally refer to topics in which there have been rapid recent developments: their inclusion does not imply a critical judgement on the original articles.

All articles in Supplementary Volume 1, are furnished with cross-references to relevant articles in the main encyclopedia as well as to other articles in this supplementary volume itself, where appropriate.

As with the Encyclopedia of Materials Science and Engineering itself the careful selection of experts by the two editors has resulted in comprehensive articles. If this standard is maintained in further supplementary volumes the encyclopedia will receive continuously increasing well justified attention and become a must for all libraries covering topics in materials science.

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Solid State Electrochemistry and its Applications to Sensors and Electronic Devices. By *K. S. Goto.* Elsevier Science Publishers, Amsterdam 1988. x, 454 pp., bound, US $ 119.50.—ISBN 0-444-42912-3.

The title of the book is somewhat misleading, implying that the coverage is much broader than it is in reality. It is in fact restricted to the electrochemistry of solid and liquid (melts, slags) oxides at temperatures in the range 200–2000 °C. The monograph is based on lecture notes of a course given by the author on this specific theme at the Tokyo Institute of Technology since 1971. About 100 "Problems" for discussion and calculations found in the appendix of the book are indicative of this origin.

The book can be divided roughly in two parts, chapters 1–9 "Fundamentals" and chapters 10–13 "Applications". In the course of the first part, which makes up about 60% of the book, a thorough treatment of the following fundamental properties of oxides is given from an electrochemical point of view:

a) Transport properties, diffusion, electronic and ionic conduction in binary oxides and multicomponent systems (chapters 2–5).

b) Thermodynamics of solid state galvanic cells, including the electrochemical Knudsen effusion cell. This is the only location, where the work of *H. Rickert* (erronneously cited throughout as "H. Richert") has been mentioned. His monographs on solid ionic electrochemistry are ignored, as is also the case (with one exception) for the pioneering work of *C. Wagner* (chapters 6–7).

c) Electrochemical kinetics. The chapters 8 and 9 are very useful and overpotential phenomena at the phase boundaries metal/solid oxide as well as metal/liquid-oxide melts are treated thoroughly. The author also introduces the use of the Pt-rotating disc electrode in $PbO-SiO_2$ melts at 1000 °C.

The final four chapters are devoted to various applications of solid state (sss) devices, with a strong emphasis on oxygen sensors for metallurgy and on MOS-sensors (another name for ISFETS; however, this term is not used in the book). In cooperation with the Japanese steel industry, the author has developed various sensor designs to measure the oxygen activity in molten iron as well as in molten slag. Typical values are 10^{-9} atm and 10^{-8} atm, respectively. Interesting correlations to the carbon content in the iron, the duration of oxygen blasting or the ratio of Fe^{III}/Fe^{II} in the slag have been found. This section is most authoritative, and the predominance of Japanese references is more justified here than in other parts of the book. The work of *Janke* et al. is also adequately discussed. Some parts, however, lie outside the scope "high temperature application" such as those in section 13.3 which include electrochromic displays, coulometric timers or pacemaker batteries. A brief account that electrochemical reactions are relevant to impurity effects and long term behavior (corrosion) of electronic devices, is given in chapter 1, but it is not followed up later in the book.

The typed manuscript has been directly reproduced, unfortunately without line balance, but typing errors are minimal. The price is high, as with many other specialized monographs, but although the variety of the possible subject matter in this area is extremely large, for example, stoichiometry, texture, phases and the result of various combinations, the book is clearly written and a guide in this broad field. It is also clear, that "in the future, many more electronic devices will surely be developed to utilize the physical and chemical properties of solid oxides".

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