general readers who are interested in applications of X-ray diffraction, especially, for example, to mineralogy rather than to metals or semiconductors, it may be helpful.

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Growth and properties of metal clusters: applications to catalysis and the photographic process. Edited by J. BOURDON. Pp. xviii + 549. Amsterdam, Oxford, New York: Elsevier, 1980. Price US $97.50, Dfl 200.00.

A conference with this title was held at Villeurbanne, France, in September 1979 in order to bring together research workers in various academic disciplines and from the different industries whose technology depends on the growth and properties of metal clusters. The book contains most of the papers presented at the conference, together with a record of the discussion after each paper and a more general panel discussion. The different papers are grouped under the titles: *Nucleation, growth, coalescence*; *Electrocrystallisation*; *Structures, physico-chemical properties, theory*; *Application to the photographic process*; *Structure and catalytic reactivity*; *Application to catalysis*.

The conference came at an appropriate time for photographic scientists since, at the previous year's International Congress held at Rochester, New York, thermodynamic theories of the formation of latent images had been established as alternatives to earlier atomistic theories. Moisar and Malinowski, the two leading exponents of this thermodynamic formalism, summarize their ideas in separate papers, that of Moisar extending the approach for the first time to consider photographic fog. Other interesting papers in the photographic section include those of Hamilton, which summarizes work on vacuum-deposited silver and gold nuclei and its relevance to latent-image theory, and Hoffman, who proposes that developability depends on the thermodynamic state of the silver halide microcrystal rather than on the size of the silver cluster (latent image).

One aspect of Malinowski's description of latent-image formation is the idea of a rapid diffusion of silver atoms on the silver halide surface. The growth and diffusion of metal clusters on substrate surfaces is described for two very different systems by Ehrlich & Stolt – rhenium on tungsten – and Wynblatt – platinum on alumina.

Other examples of physical phenomena being encountered in widely different fields are seen in the papers on electrocrystallization by Maurin & Budewski, Staikov and Bostanov. The formation of nuclei under high overpotential (high supersaturation) and their growth at an overpotential just below the critical, the tendency to form increasing numbers of twins at higher overpotential and the rapid growth of multiple twins are all familiar to those who have studied the growth from solution of inorganic crystals, including photographic silver halide emulsions.

A question which is touched upon in several different papers and examined in the panel discussion is the size at which a cluster ceases to be a cluster and adopts the properties of the bulk metal. There was general agreement that the transition size will depend on the property being measured, and the calculations of Hamilton and co-workers and Cyrot-Lackmann and the measurements by Kreibig on gold clusters in photosensitive glass all support a transition from 'cluster state' to bulk structure at a size of several hundred atoms.

The conference was a success in that it led to fruitful contact between scientists in many disciplines. In particular, papers were presented by Salem and by Cyrot-Lackmann which described two very different approaches to calculating metal-cluster–adsorbed-molecule structures, which provoked much stimulating discussion. The absence of Salem's paper in the book is a serious omission from an otherwise admirable recapture of the conference.

The book will be useful to specialists in the different fields who wish to obtain an appreciation of current work in the other fields. The paper by Moisar & Granzer may be particularly useful as an introduction to the photographic process for the non-specialist.

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Defects and diffusion in solids: an introduction. By S. MROWEC. Pp. 466. Amsterdam, Oxford, New York: Elsevier, and Warsaw: Polish Scientific Publishers, 1980. Price US$83.00, Dfl 170.00.

This is the fifth volume of a series in *Materials Science Monographs*. Professor Mrowec, a specialist in the study of defects and diffusion in solids, has made many contributions in the study of metals and their oxides and sulphides. The book is an excellent introduction to material science; it is divided into four chapters with strong emphasis on experimental aspects.

The first chapter describes briefly the most common structures of solids and their linear and planar defects. Thermodynamically reversible defects are extensively treated with an elegant discussion of point defects and their thermodynamic properties. In the section on extended defects, not included in the Polish edition, the author gives a fairly complete discussion on complexes and defect clusters. The first chapter ends with a small section on the electrical conductivity of ionic crystals that is too short to help the reader and is the weak point of the book.

The second chapter, *Diffusion in the solid state*, after a short introduction to Fick's laws, describes the basic mechanisms of lattice diffusion and the correlation effect. A short discussion on the relation between diffusion and ionic

conductivity is followed by a clear presentation of the Kirkendall–Frenkell effect, the effect of pressure on diffusion, the chemical diffusion coefficient and empirical relations.

Diffusion in crystals containing extended defects is also discussed. Using the background developed in preceding sections, experimental results on diffusion in oxides of Cr, Ni, Cu and Fe are discussed. The second chapter ends with a short presentation of diffusion along boundaries, surface diffusion and reactive diffusion.

The third chapter is devoted to a detailed description of experimental methods for the determination of defect equilibria and diffusion coefficients in solids. Emphasis is given to the classical methods, especially thermogravimetric methods, which the author has used in several of his own contributions.

Volumetric and electrochemical methods are also extensively discussed. The third chapter ends with a discussion of tracer and kinetic methods for the determination of self-diffusion coefficients and with a discussion of thermogravimetric and solid-state cells for the determination of chemical diffusion coefficients.

The fourth chapter, *Selected values of parameters of self diffusion and heterodiffusion in metals, alloys and metal oxides, sulphides and halides*, gives the activation energy and frequency factor for diffusion with its major part dedicated to metals and oxides.

The subject matter discussed and the way it is presented indicate that this book should be of interest for those involved with material science in general and especially in the areas of corrosion, oxides, metallurgy, solid-state ionic devices and ceramics. The book is written from the experimentalist's point of view with careful discussion of classical techniques used in the study of materials. The large list of references supplement well the subjects of the book.

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Thermal expansion of crystals. International series in the science of the solid state, Vol 12. By R. S. Krishnan, R. Srinivasan and S. Devanarayanan. Pp. 305. Oxford: Pergamon Press, 1979. Price £15·00, US $35.00.

In 1958 the first of the above three authors published in *Progress in Crystal Physics*, Vol. 1, a summary of data on thermal, elastic and optical properties of crystals. The present volume greatly extends the presentation there made of the thermal expansion of crystals. After a short introductory chapter the methods of measuring thermal expansions are described in detail and all the current methods are included. The chapter contains a valuable statement of the analysis necessary in crystals of low symmetry. The third chapter is a full account of the theoretical work done by many authors on the theory of thermal expansions in crystals. This is followed by a short chapter on the relation between thermal expansion and phase transitions, with special reference to ammonium compounds and to ferroelectricity. Then follow eighty pages of data on thermal expansion. This section is invaluable for anyone concerned with crystalline thermal expansion or any of the properties associated with it. The first three-quarters of this section refers to an exhaustive list for 370 substances. The temperature range involved goes up to high temperatures. The last part of the tables gives data for very low temperatures.

Finally, there are ninety-two pages of references to the original works from which the data have been taken.

The book is well produced with clear diagrams and well arranged tables. For all those who are concerned with thermal expansion in crystalline materials this work is to be highly recommended.

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Crystalline electric field and structural effects in *f*-electron systems. Edited by J. E. Crow, R. P. Guertin and T. W. Mihalisin. Pp. xii + 638. New York and London: Plenum Press, 1980. Price US$69.50.

This book is the proceedings of the international conference, on the same subject as the title, held at Temple University in Philadelphia, Pennsylvania, November 12–15, 1979. The 63 articles are divided into the following sections: 1. *Crystal field and structural effects*; 2. *Lattice effects* I; 3. *Lattice effects* II; 4. *Actinides*; 5. *Kondo and intermediate valence properties*; 6. *Transport and thermodynamic properties*; 7. *Singlet ground state and other properties*; 8. *Superconductivity*; 9. *Lifetime effects*.

A transcript of the question and answer session is found following each article. A subject index and separate material index are found at the end of the book.

One does not have to look too closely to discover errors. Thus, in the second article only 18 of the 36 references are listed at the end. However, it is almost impossible to avoid errors in a book of this type. The inclusion of the question and answer sessions is a valuable addition; however, the value is somewhat reduced since what is eventually published sometimes differs from what was presented at the conference. Thus, at the end of the second article the first question concerns the substance PrB_6 which is not mentioned in the published text.

The last crystal field conference was held in Zürich in 1976 and the conference proceedings were published by Plenum Press under the title *Crystal Field Effects in Metals and Alloys* in 1977. Since this conference, important progress has been made, especially in the understanding of crystal field effects (or the lack of these effects) in the actinides. The proceedings of the present conference bring the reader up to date on this progress.