

Book review

Minerals and Reactions at the Atomic Scale: Transmission Electron Microscopy

P. Buseck, Ed.

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The last volume of the well known *Reviews in Mineralogy* series, a publication of the Mineralogical Society of America (MSA), is devoted to Transmission Electron Microscopy (TEM) and its most recent applications to mineralogy. The book represents the proceedings of the short courses which took place in Ohio, on October 23-25, 1992, in conjunction with the MSA annual meeting.

The book is subdivided in two parts, the chapters 1-5 cover imaging, diffraction and analytical techniques available with TEM while the last seven chapters are dedicated to a compilation of the mineralogical and petrological applications of these techniques.

The first chapter, composed of the classical "Principles of Transmission Electron Microscopy", is particularly well written by P.R. Buseck. Presented on a simple and attractive form, the illustrations are particularly well chosen and clear. A table of all the acronyms used by TEM users is especially useful for newcomers in the field. The second chapter "Selected Area Electron Diffraction (SAED) and Convergent Beam Electron Diffraction (CBED)" by J.W. Steeds and J.-P. Morniroli introduces one of the most recent and most exciting developments of TEM: i.e. CBED identification of crystallographic symmetry and LACBED determination of dislocation Burgers vector. Despite the relative difficulty of these techniques, the presentation of the two authors is one of the clearest I have ever read on the subject. The third chapter "High resolution image simulation and analysis" by P. Self presents in detail why and how simulation must be performed in order to interpret correctly the HRTEM images and gives all the tricks and traps of the technique. This very easy to read chapter seems too short to the reader who would like to have more information on the image simulation of defects. Chapters 4 and 5, "AEM: X-ray analysis" by D.R. Peacor and "EELS and ALCHEMI" by P.R. Buseck and P. Self, concern the techniques of chemical analysis. The classical AEM technique is described in detail and some applications on the analysis of hydrated minerals are presented. The purpose of this chapter is not to overview the most recent developments of the technique with an exhaustive compilation of the main references on the subject. The author's aim is rather to demonstrate the capability of the AEM tool to perform reliable everyday quantitative analysis. EELS and ALCHEMI are two techniques which have been applied only recently to mineralogical materials. The important contribution of the authors for the widespread of EELS and ALCHEMI make them particularly suitable to give a good overview of these techniques.

D.R. Veblen with "Electron Microscopy Applied to Nonstoichiometry, Polysomatism, and Replacement Reactions in Minerals" (Chap. 6) gives a complete review of the HRTEM studies of the polysomatic defects in biopyriboles (pyroxenes, amphiboles, sheet silicates) and other minerals. In chapter 7, "Polytypism and Stacking disorder", A. Baronnet gives, after a review of the basic concepts of polytypism, a rich catalogue of TEM observations of polytypism in sheet silicates (micas, chlorite,...). F.M. Allen in "Mineral Definition by HRTEM: Problems and Opportunities" (Chap. 8) gives probably one of the largest compilations ever written on HRTEM works done on minerals. With more than 350 references, the author deals with chemically and structurally disor-

dered minerals, short range ordered regions (polymorphs, polytypes or polysomes) and structure identifications of minerals. "Diagenesis and Low-Grade Metamorphism of Shales and Slates" by D.R. Peacor reports all the special techniques and problems relevant to the TEM study of clay minerals. He discusses the details of the TEM observations of the microstructure and the reactions occurring along the illite-smectite-chlorite metamorphic sequence during sediments burial. Chapter 10 presents a summary of the TEM works on the "Growth and Alteration Microstructures" of Carbonates written by R.J. Reeder who is one of the main contributors in the field. The good quality TEM images chosen by the author illustrates particularly well the TEM contribution to the carbonates study. Chapter 11 is a contribution of H.W. Green II on "TEM Analysis of Deformation in Geological Materials" and gives a good overview of the numerous deformation mechanisms and microstructures observed in minerals. This chapter constitutes an excellent textbook chapter for students interested by fields as different as geophysics, mineralogy, ceramics of metallurgy. The last chapter "Imaging Transformation-Induced Microstructures" by G.L. Nord Jr. is dedicated to the TEM studies of twin and antiphase domains and tweed textures in numerous minerals: quartz, ilmenite, leucite, cordierite, feldspar, pyroxenes,...

This book should be highly recommended for a wide audience. For Earth Scientists and Mineralogists, it provides an overview of the state of current contribution of TEM to mineral studies. For Microscopists, it provides informations on new techniques and their applications (see especially the very good chapter on CBED and LACBED). For students, it provides an easy way to get a broad overview on TEM techniques. Like all books of this series, the book is available for an extremely cheap price. The volume has been especially printed on a good quality glassy paper as required by the numerous reproductions of TEM images. For all these reasons, every professor and student can afford to have his or her personal copy.

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