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Book Review

ELECTROCHEMICAL PROPERTIES OF CLAYS, volume 10 of the Clay Minerals Society Workshop Lectures (Alanah Fitch, Ed). The Clay Minerals Society, Aurora, CO, 2003, 205 pp. $26

This book consists of a compilation of five papers covering many aspects of electrochemical properties of clay minerals, metal oxides, and metal oxyhydroxides. This is an excellent reference for material scientists, chemists, and geochemists involved with this ever-expanding area of research. Applications of electrochemistry to redox-active solids are widespread, ranging from fuel cell research to environmental site restoration.

The goal of this book is to provide a wide variety of examples that couple electrochemical methods with clay mineral and metal oxide research. This goal is reached through diverse discussions on electrochemistry provided by the authors. Theoretical considerations and experimental results of both basic and applied research dealing with the electrochemistry of clay minerals are presented. Topics covered include in-depth discussions on surface chemistry properties (diffuse double layer) of clays and their importance to electrochemistry; use of clay-modified electrodes for quantifying diffusion processes within composite materials; measuring the flux of electroactive and electroinactive materials in nanocomposites of clay minerals; and environmental applications of electrochemical processes involving clay minerals and iron oxides-oxyhydroxides.

The book begins with a succinct preface by Alanah Finch. This is followed by an excellent overview on the diffuse double layer that is of interest to clay mineralogists and electrochemists, written by Susan Macha, Scott Baker, and Alanah Fitch. The authors present flux equations that are fundamental to all electrochemical experiments; they also present experimental guidelines for applying electrochemical methods to clay minerals. Akihiko Yamagishi presents two methods for preparing a thin film of clay with application of the Langmuir-Blodgett technique. The first method consists of preparing a clay single layer at an air-water interface by using a hydrophobic clay. This monolayer is deposited onto an electrode substrate. Electrochemical measurements on the electrode yield information on changing diffusion characteristics of an incorporated ion as a function of the thickness of the clay film. The second method described by Yamagishi consists of formation of a cationic monolayer that adsorbs clay particles in an aqueous suspension. In the next section J. E. Amonette presents a detailed discussion on the occurrence and electrochemical properties of iron-bearing solids. Structural, thermodynamic, and kinetic aspects influencing the reactivity of these solids are also provided by Amonette. An overview of environmental applications of iron-bearing solids for controlling redox chemistry of organic (high explosive compounds and chlorinated aliphatic hydrocarbons) and inorganic (chromate) contaminants is also presented. Gilles Villemure provides a detailed discussion on the application of synthetic clays for modifying electrode surfaces to achieve better control on the chemical composition of modifying films than is possible with natural clay minerals. Villemure provides experimental results suggesting that synthetic minerals enhance incorporation of transition metals into clay layers to a greater extent than observed with natural clay minerals. Evangelos Manias, Athanassios Z. Panagiotopoulos, David B. Zax, and Emmanuel P. Giannelis present results of computer simulations and experimental results for synthesis of polymer electrolyte nanocomposites by direct melt and solution intercalation of polyethylene oxide in layered silicates. These authors report that a new and unexpected understanding for nanocomposite electrolytes is emerging. Cations remain bound to the silicate host surface while the intercalated polymer chains adopt adopt a disordered, random configuration within the host galleries. The intercalated polyethylene oxide chains exhibit substantial segmental motion below the bulk glass transition temperature in the presence of "confining " host layers.

Each paper in this volume provides legible tables and figures and numerous, up-to-date references are made available by the authors. Reproduction of several figures in the book, however, is of variable quality. A glossary is not included with the book but definitions of scientific terms and concepts are generally provided in each paper. Most of the authors provide a summary or conclusions at the end of each paper. Several minor typos are present throughout the book. Overall, this is an interesting book and it is a welcomed addition to the field of mineral electrochemistry.

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