

Preface

This book is intended to be a concise and comprehensive coverage of the key ceramic and glass materials used in modern technology. A group of international experts have contributed a wide ranging set of chapters that literally covers this field from A (Chap. 1) to Z (Chap. 10). Each chapter focuses on the structure–property relationships for these important materials and expands our understanding of their nature by simultaneously discussing the technology of their processing methods. In each case, the resulting understanding of the contemporary applications of the materials provides insights as to their future role in twenty-first century engineering and technology.

The book is intended for advanced undergraduates, graduate students, and working professionals. Although authored by members of the materials science and engineering community, the book can be useful for readers in a wide range of scientific and engineering fields.

Robert Doremus of the Rensselaer Polytechnic Institute covers one of the most ubiquitous modern ceramics in Chap. 1. The popularity of alumina by itself and as a component in numerous ceramic and glass products follows from its wide range of attractive properties. In Chap. 2, Duval, Risbud, and Shackelford of the University of California, Davis, look at the closely related and similarly ubiquitous material composed of three parts of alumina and two parts of silica, the only stable intermediate phase in the alumina–silica system at atmospheric pressure. Mullite has had significant applications in refractories and pottery for millennia and new applications in structures, electronics, and optics are the focus of active research. Richard Bradt of the University of Alabama, Tuscaloosa, provides Chap. 3, a focused discussion of the intriguing minerals (andalusite, kyanite, and sillimanite) that do not appear on the common alumina–silica phase diagram as they are formed at high geological pressures and temperatures. Nonetheless, these minerals with a one-to-one ratio of alumina to silica are widely found in nature and are used in numerous applications such as refractories for the steel and glass industries. In Chap. 4, Martin Wilding of the University of Wales, Aberystwyth, further expands the compositional range of materials considered by exploring the ceramics and glasses formed in binary aluminate systems. Sharing the high melting point and chemical resistance of the alumina end-member, these aluminates find a wide range of applications from cements to bioceramics and electronic components.

In Chap. 5, Davila, Risbud, and Shackelford of the University of California, Davis, review the various ceramic and glass materials that come from silica, the most abundant mineral in the Earth's crust. The many examples they give share a simple chemistry but display a wide range of crystalline and noncrystalline structures. The materials also represent some of the most traditional ceramic and glass applications as well as some of the most sophisticated, recent technological advances. In Chap. 6, Smith and Fahrenholtz of the University of Missouri, Rolla, cover a vast array of ceramic materials, including many of the materials covered in other chapters in this book. The resulting perspective is useful for appreciating the context in which ceramics are used for one of their most important properties, viz. the resistance to high temperatures. Professor Fahrenholtz then provides a comprehensive coverage of clays in Chap. 7. These important minerals that serve as raw materials for so many of the traditional ceramics are also providing a framework for the science of the study of advanced ceramics. In Chap. 8, Mariano Velez of the Mo-Sci Corporation reviews the ceramic oxides that are used for the two distinctive markets of (a) structural applications and (b) high temperature (refractory) concretes.

Professor Julie Schoenung of the University of California, Davis, reviews a wide range of minerals in Chap. 9. These materials produce the various lead oxides and silicates so widely used in lead-containing glasses and crystalline electronic ceramics. The regulatory issues surrounding these well known carcinogenic materials are also discussed. Finally in Chap. 10, Olivia Graeve of the University of Nevada, Reno, reviews the complex structural and processing issues associated with the family of ceramics zirconia that is widely used because of the superior values of toughness and ionic conductivity.

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Davis, CA
Troy, NY

Shackelford
Doremus

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Shackelford, J.; Doremus, R.H. (Eds.)
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