Preface

This textbook presents a general review of the *Mechanical Properties of Ceramics* and aims to provide an overall understanding of the subject. It surveys the various behaviors characteristic of ceramics in response to applied forces. The present approach emphasizes common denominators in the responses of all these materials to certain applied forces, while delineating the differences found between various classes of the large families of materials. By discussing the general mechanical behaviors of ceramics as a whole, rather than the specific behaviors of each type of ceramic separately, it is hoped that the readers, students, and engineers alike, will understand that these mechanical properties are governed by physical laws common to them all and relevant to all their applications.

The book has been arranged in a manner different from that found in many, if not most, of the textbooks dealing with mechanical behavior and follows, to some extent, the same framework established in my earlier book on the Mechanical Properties of Materials. As such, Chap. 1 presents all the basic tests and equations useful for a student entering a materials testing laboratory for the first time. Chapter 2 shows that there are ductile ceramics also at ambient temperature and discusses ductility at elevated temperatures, superplasticity, and other features directly influencing ductility or related to their strength properties. Chapter 3 establishes the theoretical foundations of mechanical properties and considers imperfections—point defects and dislocation-related concepts, setting the background for experimental observations. In Chap. 4, deformations, elastic and plastic, are discussed both at low and elevated temperatures, as are slip and twinning. Here, high-temperature deformation is emphasized, because even ceramics that are brittle at room temperature show some ductility at high temperatures. Ceramic strength and strengthening mechanisms are dealt with in Chap. 5. Time-dependent deformation (creep) is the subject of Chap. 6 and ceramics that are brittle or ductile at room temperature and superplastic ceramics are discussed. This chapter also considers the phenomenon of rupture and the design of materials to prevent creep. Cyclic deformation (fatigue) in ceramics is broadly discussed in Chap. 7, whereas static, time-dependent fracture, dynamic deformation and the theoretical strength of materials are the subjects of Chap. 8. In the ninth and final chapter, small grain-sized ceramics, in the nanosize range, are considered.

Actual problems are not presented for solution, so that each lecturer may devise his/her own problems to challenge the students. There is no need to repeat problems that appear in other textbooks. Suffice it to say that those interested in conceiving of practical problems that may arise in the field are encouraged to seek them (and their probable solutions) for their own benefit.

I would like to express my gratitude to all publishers and authors for permission to use and reproduce some of their illustrations and microstructures.

Finally, without the tireless devotion, help, understanding, and unlimited patience of my wife Ada, I could never have completed this book, despite my decades of teaching in this field; her encouragement was essential and her helpful attitude was instrumental in inspiring to write this book. Thanks to Ethelea Katzenell of Ben-Gurion University for improving the English.

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