

PREFACE

This is an advanced text book on the microstructure and properties of materials, the first volume of a possible 3-volume set. While there are many elementary text books in materials science, there are very few advanced text books. In our graduate school courses, we rely on our own notes or some conference volumes and journal articles. One of the reasons is that there are so many different kinds of materials and each has its own microstructure property characteristics. So it is difficult for a single person to be expert in all the materials. Thus the idea of a multi-author collection appears good. I am inviting the best authoritative expert that I can find in each material area and since they are all busy people, it has taken longer than expected to finish the task. Hence this is the first volume which should be a good supplement to your microstructure course. If you are working with a certain material area in one of the chapters, you will find a rich source of design ideas and applications as well as a good understanding of how does the microstructure affect the properties.

Chapter 1 on aluminum alloys presents microstructural optimization and critical considerations in design applications. Chapter 2 on Nickel-base superalloys reviews the compositional, microstructural and processing advances in increasing their maximum use temperature. Chapter 3 on metal matrix composites discusses the strengthening mechanisms of metals dispersed with short fibers or particles. Chapter 4 on polymer matrix composites contains the details of the microstructure property relationships of high performance fibers, polymer matrix material and the advanced composites made therewith. Chapter 5 on ceramics matrix composites describes the fibers and matrix materials used, the processing techniques involved and the mechanical properties under different loading conditions. Chapter 6 on inorganic glasses describes the influence of second phases, both glassy and crystalline on their properties. Chapter 7 on superconducting materials shows the importance of twins, grain boundaries, dislocations and stacking faults. Chapter 8 on magnetic materials introduces the domain structure and its effects on the soft and hard magnetic properties.

Material problems are the bottle necks of most industries. New materials are created daily. But the principles and the relation between properties and microstructure remains the same. The more we know about these relations the easier will be to find new materials with desired properties.

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