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Intermetallic Matrix Composites

Properties and Applications

Edited by Rahul Mitra

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Intermetallic matrix composites comprise a class of materials having properties between that of metals and ceramics. Selected group of intermetallic composites based on aluminides and silicides are considered interesting for high temperature applications due to high melting points, as well as the ability to retain strength and resist environmental degradation. This book is a comprehensive guide covering different types and properties of intermetallic matrix composites.

Part One analyzes both types and properties of intermetallic matrix composites, including iron aluminides, nickel aluminides, titanium aluminides, molybdenum silicides, and aluminum-based matrix composites reinforced with intermetallic phases. Part Two focuses on processing and characterization methods, and includes chapters on liquid metallurgy processing, self-propagating high temperature synthesis, as well as techniques for joining, hot pressing, and spark plasma sintering. The concluding section, Part Three, discusses modeling techniques, strengthening, failure, and repair. Chapters in this part cover oxidation and environmental degradation, ductile phase toughening, functionally gradient composites, and the role of intermetallics in corrosion of aluminum alloys and smart coatings protection.

Intermetallic Matrix Composites is a technical guide for professionals requiring basic information and also offers a deeper understanding of the subject for interested researchers and engineers.

Rahul Mitra is a Professor at the Indian Institute of Technology (IIT), Kharagpur, India. He received B.Tech (Hons.) from IIT Kharagpur in 1988, and PhD from Northwestern University, USA in 1992. His research has focused on silicide-based intermetallics and ceramic matrix composites for more than two decades. He has so far authored or co-authored more than 125 peer-reviewed journal publications, two patents, and a book.

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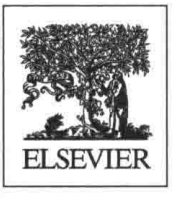

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Preface

Significant research has been carried out for several decades on structural intermetallics and intermetallic-matrix composites, being driven by the need of aerospace-, power-, automotive-, and defense-related industries for materials operating at elevated temperatures or extreme environments. Although the structure-property relations of these materials are reasonably well understood, further research is in progress at different laboratories of the world to improve upon the issues inhibiting their widespread usage for several diverse engineering applications. Particular attention has been paid by several researchers to develop selected multicomponent intermetallic alloys based on silicides and aluminides with composite microstructures having mixtures of ductile and relatively harder phases with the objective of achieving desirable toughness at ambient temperature along with the ability to retain strength and resist environmental degradation at elevated temperatures. Design of intermetallic-matrix composites with suitable ceramic reinforcements and optimized volume fractions have also led to unique combination of desirable properties. However, formidable challenges still remain in improving upon impact toughness and devising economically viable methods of processing and scale-up.

A student learner often finds it difficult to grasp the complexities of structure of intermetallics, and their effect on various physical and mechanical properties. Keeping the requirement of students in mind, the chapters in this edited book on *Intermetallic Matrix Composites* contain necessary fundamental aspects along with updated reviews of existing literature to support the requirements of researchers. Followed by an introductory overview of structural intermetallics and intermetallic-matrix composites, there is part I focused on types and properties of intermetallic-matrix composites. This part contains chapters on nickel aluminides, iron aluminides, titanium aluminides, molybdenum silicides, and intermetallic phases used as reinforcements. Subsequently, part II with focus on processing and characterization contains chapters on liquid metallurgy processing, self-propagating high-temperature synthesis, bonding/joining techniques, hot pressing and spark plasma sintering techniques, and reactive and liquid-phase sintering techniques. Finally, part III has been dedicated to modeling techniques, strengthening, failure, and repair. It contains chapters on oxidation and environmental degradation, intermetallic composites toughened with ductile reinforcements, functionally graded intermetallic composites, and role of intermetallics in corrosion of aluminum alloys and smart coating protection.

The editor would like to express his sincere gratitude to all the authors for sparing their valuable time and efforts to contribute excellent chapters, so that this edited book sees the light of the day. It is really hard to find suitable words to acknowledge the persistent efforts of Ms. Charlotte Cockle and her team members at Woodhead Publishers (Elsevier), who have tirelessly worked with all the authors to complete the book. The editor is also personally indebted to his students and particularly to his wife, Mrs. Barnali Mitra, for bearing with him during completion of this work.

Rahul Mitra

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