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3.3 New Geometric Measures for Finite Carbon Nanotubes3.4 Materials Having Network Structures; 3.4.1 Mathematical Technique Predicts Molecular Magnet; 3.4.2 Mixing Time of Molecules Inside of Nanoporous Gold; References; 4 Breakthroughs Based on the Mathematics--Materials Science Collaboration; 4.1 Real Interdisciplinary Integration; 4.2 Organization Promoting Mathematics--Materials Science Collaboration; 4.3 Specific Problems and Applications in the Future; 5 Epilogue; References; Appendix A Supplements to "Quantum Materials"

Sommario/riassunto

This book is the first volume of the SpringerBriefs in the Mathematics of Materials and provides a comprehensive guide to the interaction of mathematics with materials science. The anterior part of the book describes a selected history of materials science as well as the interaction between mathematics and materials in history. The emergence of materials science was itself a result of an interdisciplinary movement in the 1950s and 1960s. Materials science was formed by the integration of metallurgy, polymer science, ceramics, solid state physics, and related disciplines. We believe that such historical background helps readers to understand the importance of interdisciplinary interaction such as mathematics–materials science collaboration. The middle part of the book describes mathematical ideas and methods that can be applied to materials problems and introduces some examples of specific studies—for example, computational homology applied to structural analysis of glassy materials, stochastic models for the formation process of materials, new geometric measures for finite carbon nanotube molecules, mathematical technique predicting a molecular magnet, and network analysis of nanoporous materials. The details of these works will be shown in the subsequent volumes of this SpringerBriefs in the Mathematics of Materials series by the individual authors. The posterior section of the book presents how breakthroughs based on mathematics–materials science collaborations can emerge. The authors' argument is supported by the experiences at the Advanced Institute for Materials Research (AIMR), where many researchers from various fields gathered and tackled interdisciplinary research.