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Applying Machine Learning in Materials Science -- Emerging Challenges and Future Directions in Multiscale Modelling for Integration of Biology and Materials Design -- Machine Learning in Materials Science: Current Challenges and Future Outlook.

Sommario/riassunto

This book bridges the gap between conventional materials science and emerging data-driven methodologies, highlighting the integration of AI, machine learning, and deep learning technologies to enhance the design, analysis, and optimization of smart materials. It provides a holistic perspective essential for researchers, engineers, and students exploring the intersection of materials engineering and AI technologies. The book examines the connection between recent advancements in materials science and multiscale machine learning, facilitating predictive and prescriptive modeling for assessing material behavior based on composition, structure, and processing. It includes comprehensive discussions on smart material design, optimization, complexity analysis, and advanced computational methods for synthesizing and characterizing materials. Challenges in multiscale modeling, such as biologically inspired material design and the influence of nanotechnology on current trends, are thoroughly explored. Emphasizing the critical role of multiscale machine learning and nanotechnology in creating sustainable smart materials, the book also addresses the ethical implications of this research. It discusses opportunities and challenges in biomaterials, particularly in healthcare and biomedical applications, and anticipates future trends in machine learning for sustainable materials design. The book provides insights into how predictive and prescriptive modeling through machine learning can accelerate the material discovery process, guiding researchers toward promising candidates for further exploration. Serving as a roadmap for researchers and scientists, this book offers valuable insights into innovative approaches that support the future of materials science.