

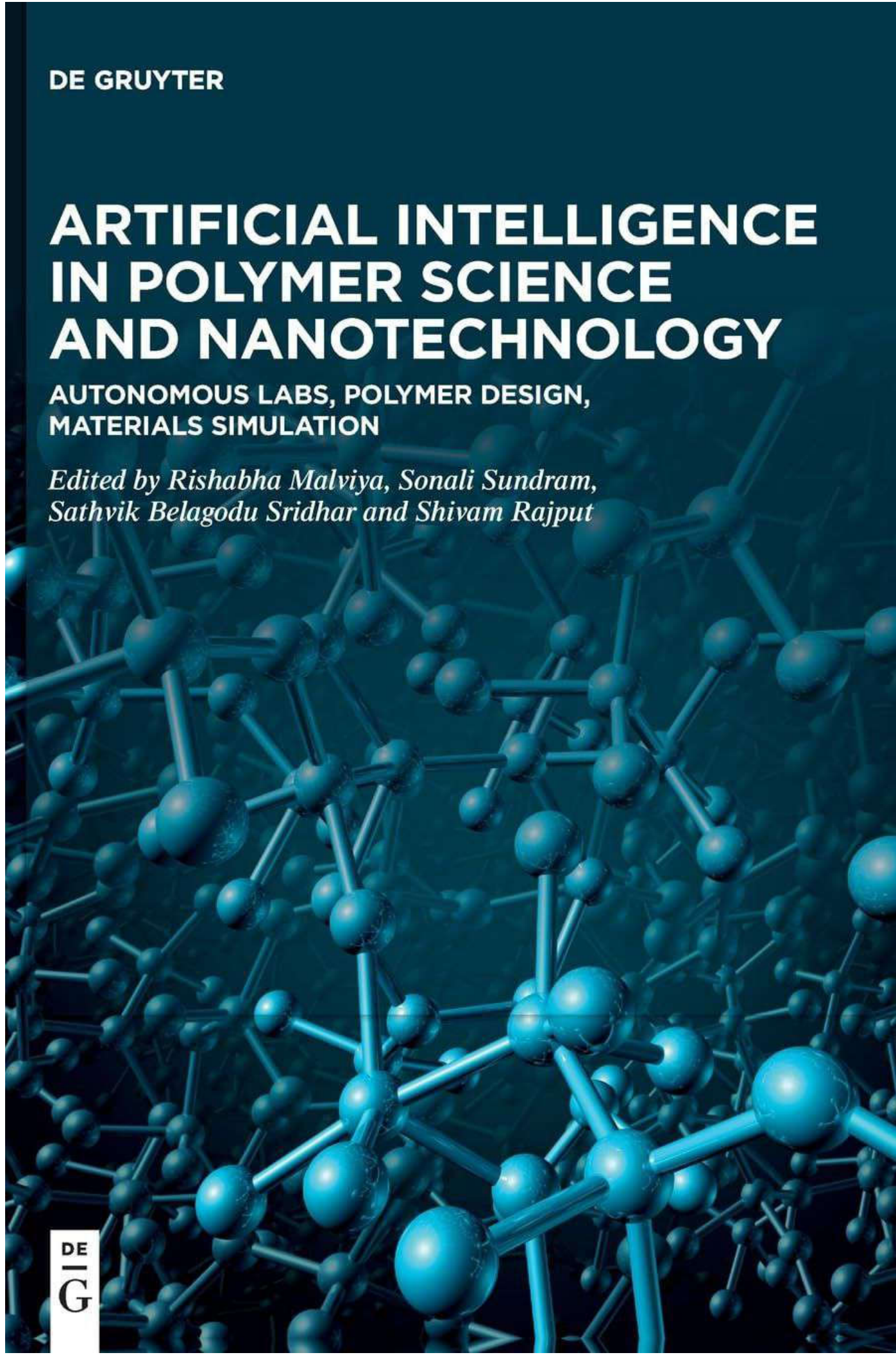
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ARTIFICIAL INTELLIGENCE IN POLYMER SCIENCE AND NANOTECHNOLOGY

AUTONOMOUS LABS, POLYMER DESIGN,
MATERIALS SIMULATION

*Edited by Rishabha Malviya, Sonali Sundram,
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Chapter 1

Nanotechnology innovation: AI-enhanced polymer drug delivery systems

Abstract: The confluence of polymer nanotechnology with artificial intelligence (AI) is revolutionizing drug development and targeted drug delivery, ensuring unprecedented precision in therapeutics. By coupling data analytics with AI-driven polymeric nanocarrier systems, the technology surpasses the constraints of traditional drug delivery, including bioavailability and patient-specificity, by virtue of superior design, encapsulation efficiency, and controlled release mechanisms for the drug. Predictive modeling and machine learning algorithms aid AI in optimizing drug–polymer interaction and optimizing the physicochemical characteristics of polymer nanocarriers so that therapeutics are released accurately and controllably at target sites to reduce side effects. AI's capability to forecast the interaction of disease-specific, biocompatible, and responsive polymers for patient profiles advances the principle of precision medicine. Improved encapsulation efficiency and optimized kinetics by AI-driven processes maximize the direct delivery of therapeutics to the target site with optimal doses for enhanced bioavailability and therapeutic efficacy. The amalgamation of AI with polymeric nanotechnology thus enables drug discovery in the rapid prototype and optimization of nanocarrier systems to deliver precise, individualized drug delivery with high accuracy to diverse therapeutic domains. This chapter discusses the development potential of AI-fortified polymer-based drug delivery systems, their ability to maximize the efficacy and selectivity of treatment regimens. With AI-driven innovation, polymer nanotechnology has the ability to improve patient treatment through highly personalized and potent medical options, beginning a new era of tailored medicine and new paths of drug innovation.

Keywords: Artificial intelligence, targeted drug delivery, polymeric nanocarriers, nanotechnology, precision medicine, machine learning, personalized treatment

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