Engineered Biomimicry

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Engineered Biomimicry: Chapter 6. Muscular Biopolymers

This chapter discusses properties and characteristics of ionic biopolymer-metal nanocomposites (IBMCs) as biomimetic multifunctional distributed nanoactuators, nanosensors, nanotransducers, and artificial muscles. This chapter also presents techniques on how biopolymers such as for example chitosan and perfluorinated ionic polymers could be combined to make fresh nanocomposites with actuation, energy harvesting, and sensing capabilities. After presenting some fundamental properties of biomimetic distributed nanosensing and nanoactuation of ionic polymer-metallic composites (IPMCs) and IBMCs, the discussion extends to some recent advancements in the manufacturing techniques and 3-D fabrication of IBMCs and some latest modeling and simulations, sensing and transduction, and item development. Two ionic versions based on linear irreversible thermodynamics and also charge dynamics of the underlying sensing and actuation mechanisms are also offered. The making methodologies are briefly discussed, and the essential properties and features of biopolymeric muscle tissue as artificial muscle groups are presented. Chitin-structured chitosan and ionic polymeric networks containing conjugated ions which can be redistributed by an imposed electric powered field and consequently act as distributed nanosensors, nanoactuators, and artificial muscle tissues are also discussed. Intercalation of biopolymers and ionic polymers and subsequent chemical plating of them with a noble steel by a reduction-oxidation (redox) operation is also reported and the properties of the brand new item are briefly discussed.