



Engineered Biomimicry: Chapter 6. Muscular Biopolymers

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

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