Recent Advances in Ionic Polymer Metal Nanocomposites As Distributed Biomimetic Nanosensors, Nanoactuators and Artificial Muscles

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Recent research and development advances made in connection with Ionic Polymeric-Metal Nano Composites (IPMNC's) as distributed biomimetic nanosensors, nanotransducers, nanoactuators, nanorobots and artificial muscles are presented. A review of the fundamental properties and characteristics of IPMNC's will first be presented. This summary will include descriptions of the basic materials' molecular structure, sulfonyl fluoride vinyl ether (SFVE) copolymerization with tetrafluoroethylene (TFE) to form the basic material resin and subsequent hydrolysis to manufacture the basic material for chemical plating and electroactivation. Further described are chemical molecular plating technologies to make IPMNC's, nanotechnologies of manufacturing and trapping of nanoparticles, SEM, TEM, SPM and AFM characterization of IPMNC's, biomimetic sensing and actuation characterization techniques, electrical characterization and equivalent circuit modeling of IPCC's as electronic materials. The recent advances made in manufacturing of 3-D IPMNC's and artificial muscles will also be presented.

A phenomenological model of the underlying sensing and actuation mechanisms is also presented based on linear irreversible thermodynamics with two driving forces, an electric field and a solvent pressure gradient and two fluxes, electric current density and the solvent flux.