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Novel Ionic polymer nano-composite (IPNC) actuator and sensor for biomedical applications

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Abstract

Ionic polymer composite material is one of the emerging classes of electroactive polymers and functional smart materials that can be made into soft bending actuators and sensors. Ionic polymer materials offer significant advantages over conventional electromechanical materials and systems due to their compact sizes, light weight and the ability to be tailored into any shape from the fabricated material. The fabricated device only requires relatively small voltage (1-3V) to operate it. The ionic polymer actuator can respond to small electric stimulus by generating large bending deformation, while the ionic polymer sensor responds to mechanical deformation (or vibration) by generating electrical signals. The sudden bent of the ionic polymer produces a small voltage (in the range of mV). In addition, the actuating/sensing function can be modified by changing the micro-structure, the electrical input, the cation composition, and the solvent type and amount. Conventional ionic polymer composite uses perfluorinated ion-exchange polymers as base polymers, such as a perfluoro-sulfonic polymer (Nafion®) and perfluoro-carboxylic polymer (Flemion™). Our facility not only develop a new fabrication method to greatly reduce the processing time but the performance (eg. force output and actuation) of the material made by Hitachi Chemical sulfonated ionic polymer also exceeds other conventional materials. The material is biocompatible and can be operated in various kinds of solvents. It may be developed to provide new, self-integrated material systems for biomedical and robotic applications.

Biography

Dr. Anthony Tsai is a research scientist in Hitachi Chemical Research Center. He completed Ph.D. in Material Science from University of California, Irvine. He has made contribution in the areas of surface modification, micro drug delivery systems, IPNC, and biosensors. His current interest is focus on polymer and nano materials for biomedical applications.

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