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Electro-responsive poly(lactic acid) filled with multi-walled carbon nanotubes

Abstract

The electroactive materials based on biopolymers have steadily received attentions for biomedical and actuator applications due to its biodegradability, biocompatibility and good mechanical properties. In this work, the multi-walled carbon nanotubes (MWCNTs), carbon-based nanoparticles, were used as an effective filler in the electro-responsive poly (lactic acid) fabrication. Dibutyl phthalate (DBP) was used as a plasticizer to improve flexibility and electromechanical response of the PLA composites. The effects of MWCNT concentration and electric field strength on electromechanical properties were investigated using a melt rheometer and by bending measurement. The highest storage modulus sensitivity (ΔG' /G' 0) of 1.56 belonged to the 0.1%v/v MWCNT/PLA/DBP composite at the electric filed strength of 1.5 kV/mm. At a MWCNT concentration higher than 0.8%v/v, the storage modulus response (ΔG') became negative, in which the storage modulus under electric field (G') was lower than the initial storage modulus (G' 0) without electric field. This behavior can be referred to as the negative electrostriction as similarly observed in the plasticized PLA embedded with graphene. All composites possessed the electromechanical reversibility in the temporal response experiments under applied electric field. In the bending measurement, the bending distances and dielectrophoresis forces of all specimens increased monotonically with increasing electric field strength. The MWCNT/PLA/DBP composite deflected towards the anode even at the low electric field strength of 25 V/mm. From the experimental data, the MWCNT/PLA/DBP nanocomposites provided good recoverability, high storage modulus sensitivity, and fast response time under applied electric fields. Thus, they can be potentially used as the electro active materials in soft actuator applications.

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Biography

Sirivat A received B.S. in 1977 and M.E. in 1978 followed by Ph.D. in 1983 all in Mechanical Engineering, from Cornell University, USA, and later completed a Post-Doctoral study in Chemical Engineering in 1985 from Johns Hopkins University. Sirivat A is a Professor of Polymer Engineering, Petroleum and Petrochemical College, Chulalongkorn University, Bangkok. His fields of interest are conductive and electroactive polymers; rheology, stability, transition, and turbulence of complex fluids; and light scattering.

Publications

Pongpol Choeichom and Anuvat Sirivat, High sensitivity room temperature sulfur dioxide sensor based on conductive poly(p-phenylene)/ZSM-5 nanocomposite(2020), Journal of Analytica Chimica Acta

Nuchnapa Tangboriboon, Jularpar Suttiprapar, Sairung Changkhamchom, Anuvat Sirivat, Alternative green preparation of mesoporous calcium hydroxyapatite by chemical reaction of eggshell and phosphoric acid(2019), International Journal of Applied Ceramic Technology

Pongpol Choeichom and Anuvat Sirivat, Discriminative sensing performances of ZSM-5, Y, mordenite, ferrierite, beta, 3A, 4A, 5A, and 13X zeolites towards sulfur dioxide(2018), IONICS

Wanar Kongkaew, Watchara Sangwan, Wanchai Lerdwijitjarud, Anuvat Sirivat, Soft poly(2-chloroaniline)/pectin hydrogel and its electromechanical properties(2017), Journal of Biomaterials Applications

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