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Development of a Highly Flexible, Sensitive and Stretchable Polymer Nanocomposite for Strain Sensing

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Abstract : Although several strain sensors based on carbon nanotubes (CNTs) have been reported, the stretchability and sensitivity of these sensors have remained as a challenge. Highly stretchable and sensitive strain sensors are in great demand for human motion monitoring and human-machine interface. This paper reports the fabrication and characterization of a new type of strain sensors based on a stretchable fluoropolymer / CNT nanocomposite system made via melt-mixing technique. Electrical and mechanical characterizations were obtained. The results showed that this nanocomposite sensor has high stretchability up to 280% of strain at an optimum level of filler concentration. The piezoresistive properties and the strain sensing mechanism of the strain sensor were investigated using Electrochemical Impedance Spectroscopy (EIS). High sensitivity was obtained (gauge factor as large as 12000 under 120% applied strain) in particular at the concentrations above the percolation threshold. Due to the tunneling effect, a non- linear piezoresistivity was observed at high concentrations of CNT loading. The nanocomposites with good conductivity and lightweight could be a promising candidate for strain sensing applications.

Keywords : carbon nanotubes, fluoropolymer, piezoresistive, strain sensor
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