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# Stretchable and Flexible Thermoelectric Polymer Composites for Self-Powered Volatile Organic Compound Vapors Detection

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**Abstract :** Thermoelectric devices generate an electrical current when there is a temperature gradient between the hot and cold junctions of two dissimilar conductive materials typically n-type and p-type semiconductors. Consequently, also the polymeric semiconductors composed of polymeric matrix filled by different forms of carbon nanotubes with proper structural hierarchy can have thermoelectric properties which temperature difference transfer into electricity. In spite of lower thermoelectric efficiency of polymeric thermoelectrics in terms of the figure of merit, the properties as stretchability, flexibility, lightweight, low thermal conductivity, easy processing, and low manufacturing cost are advantages in many technological and ecological applications. Polyethylene-octene copolymer based highly elastic composites filled with multi-walled carbon nanotubes (MWCTs) were prepared by sonication of nanotube dispersion in a copolymer solution followed by their precipitation pouring into non-solvent. The electronic properties of MWCNTs were moderated by different treatment techniques such as chemical oxidation, decoration by Ag clusters or addition of low molecular dopants. In this concept, for example, the amounts of oxygenated functional groups attached on MWCNT surface by $HNO_3$ oxidation increase p-type charge carriers. p-type of charge carriers can be further increased by doping with molecules of triphenylphosphine. For partial altering p-type MWCNTs into less p-type ones, Ag nanoparticles were deposited on MWCNT surface and then doped with 7,7,8,8-tetracyanoquino-dimethane. Both types of MWCNTs with the highest difference in generated thermoelectric power were combined to manufacture polymeric based thermoelectric module generating thermoelectric voltage when the temperature difference is applied between hot and cold ends of the module. Moreover, it was found that the generated voltage by the thermoelectric module at constant temperature gradient was significantly affected when exposed to vapors of different volatile organic compounds representing then a self-powered thermoelectric sensor for chemical vapor detection.

**Keywords :** carbon nanotubes, polymer composites, thermoelectric materials, self-powered gas sensor
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