Photo-mechanical actuation of elastomer/carbon nanotubes nanocomposites

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Enormous efforts of researcher are focused on the exploitation of carbon nanotubes (CNT) and their extraordinary properties in many applications as nanocomposites, sensors and actuators, field emission displays, nanoelectronics, etc. Tactile actuators based on polymer/CNTs composites are promising materials for the development of new types of visual-aid tablet for visually impaired people. However, when CNT are used as the nanofiller in polymeric matrices, problems appear with dispersion and agglomeration of CNT and compatibility with the polymeric matrix during the processing. One way to solve these problems is the surface modification of CNT which can be covalent or noncovalent. For preparing nanocomposites the non-covalent modification of MWCNT surface was carried out using compatibilizer consisting of pyrenyl and cholesteryl group [1, 2]. Nanocomposites based on ethylene-vinylacetate copolymer (EVA) and various amount of modified MWCNT were prepared by solution casting and tested as sensors and actuators. The photo-actuation measurements of the stretched nanocomposites containing modified CNT were performed using LED as light source. The photo-actuation measurements were performed on the stretched strips containing either the virgin EVA polymeric matrix or the EVA nanocomposite with MWCNT. The response of the materials to the light was studied by dynamical mechanical analysis (DMA) and scanning electron microscopy (SEM). DMA results showed that pure non-stretched EVA matrix exhibited expansion when exposed to the light. When composites in the form of strips are uniaxial pre-stretched more than 20 % of their original length, composites showed contraction when illuminated by LED. EVA nanocomposite containing 0.1 wt.% modified MWCNT showed the best results, exhibiting stresses between 33 to 165 kPa as a function of the light intensity and irradiation time. Very good repeatability of photo-actuation process up to 100 cycles was observed [3]. High optical-to-mechanical energy conversion factor of 55 MPa W^{-1} for EVA nanocomposite containing 0.1 wt.% MWCNT during illumination by red light-emitted diode was found. Another important advantage of the present EVA/CNT nanocomposites is that all of their components are commercially available and their mixing process is easy to standardize, which enables its mass production and reduces costs.

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References

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