Dispersion of multi-walled C nanotubes into cross-linkable polyethylene glycol monoacrylate: Effects on development of crosslink density, viscoelasticity and swelling

Kalyon Dilhan M. , Vural Seda, Dikovics Kimberly

Multi-walled carbon nanotubes, CNT, were compounded into a crosslinkable Newtonian fluid (photo initiator mixed with polyethylene glycol monoacrylate (PEGMA)) in the volume percent, φ, range of 0.01 to 0.5%. The linear viscoelastic material functions of the uncured PEGMA/CNT suspensions depended on the state of the dispersion of the nanotubes as affected by the sonication conditions. The dynamic properties, especially the storage modulus, increased with the better dispersion of the CNTs into an interconnected network, with the behavior of the PEGMA/CNT suspensions approaching gel-like behavior as the concentration of CNT reached φ=0.5%. Upon uv-curing of PEGMA/CNT the dynamic properties decreased significantly with the increasing concentration of CNTs indicating that the formation of the CNT network prior to curing decreased the mobility of PEGMA matrix to give rise to a reduction in the crosslink density of the PEGMA/CNT. The decrease of the crosslink density of the hydrogels gave rise to the increases in their rates of swelling and degradation in water, suggesting that the ultimate properties of CNT incorporated hydrogels depend on the microstructure that is developed during the compounding of the CNT, which in turn affects the crosslink density and hence the ultimate properties of the hydrogels.