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A. Gopinath, Mamangam Subaraja, A. Sultan Nasar

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Fluorescent shape-memory hyperbranched polyurethanes: Synthesis, characterization and evaluation of cytotoxicity

A. Gopinath[1], Mamangam Subaraja[2] and A. Sultan Nasar[1]*

[1]Department of Polymer Science, University of Madras, Guindy Campus, Chennai 25, India.
[2]Department of Plant Biology and Biotechnology, Loyola College, Chennai 34, India.
*Corresponding author E-mail: drasultannasar@yahoo.com and drasultannasar@unom.ac.in

Abstract

Fluorescent shape-memory hyperbranched polyurethanes were prepared via A_2 + B_3 approach using stilbene based fluorescent molecules as B_3 monomers and poly(ε-caprolactone) diol and its polyurethane prepolymer as A_2 monomers. Variations in the polymerization method, reaction time, reaction temperature, A_2:B_3 monomer ratio and end-group modification resulted polymers with molecular weight (M_w) in the range of $3.48x10^4$ - $6.8x10^5$ g mol^{-1} as determined by SEC-MALS technique. Polymers prepared using hydroxyl-terminated polyurethane prepolymer were characterized by TGA, DSC, WAXD, shape-memory test, UV-visible and fluorescence spectroscopic techniques. The crystallinity of polymers determined from WAXD data were found consistent with that determined from DSC data. Among the considerable number of polymers synthesized, the polymers end-capped with polyethylene glycol monomethyl ether exhibited film formation, thus these polymers were tested for their shape-memory effect and fluorescence properties. It was found that these polymers attained 100% shape recovery within 12 seconds at 50 °C or within 4 seconds at 60 °C. Absorption and fluorescence spectroscopic data of polymer film confirmed that these polymers were red-light emitting fluorescent. The adhesion and proliferation data obtained with neuroblastoma cell validated the biocompatibility of these polymers.