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Polymer-SWCNT Nanohybrids Prepared via RAFT/MADIX Polymerization

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Extended Abstract

Materials composed of carbon nanotubes (CNT) and polymers due to the combination of their mechanical, electrical, and chemical properties hold significant promise for the development of electronics (Díez-Pascual and Gascón, 2013), supercapacitors (Cheng et al., 2013), and sensing materials (Rajabi et al., 2013).

The present study demonstrates covalent functionalization of single walled carbon nanotubes (SWCNT) with polymers via RAFT/MADIX (reversible addition-fragmentation chain transfer/ macromolecular design by interchange of xanthates) polymerization. RAFT/MADIX technique allows for producing polymers with well-controlled macromolecular properties from numerous monomer types in organic solvents or water under mild pressure and temperature conditions. It is highly tolerant to functional groups and due to the presence of active end groups it enables to obtain block copolymers (Taton et al., 2001).

The first part of the project involved covalent functionalization of single walled carbon nanotubes with ethyl dithiocarbonate (xanthate). Birch reduction of SWCNT was followed by epoxidation with dimethyldioxirane and ring-opening reaction with ethyl potassium dithiocarbonate (Markiewicz et al., 2014). Dithiocarbonates (xanthates) are the chain transfer agents (CTA) in RAFT/MADIX polymerization. Their presence at SWCNT allows for the initiation and the propagation of polymer chains directly from the nanotube surface. This approach is called 'grafting from' and is promising since it provides control over the composition, density, thickness, and architecture of the grafted polymers.

In the next step, RAFT/MADIX polymerizations of various monomers 'grafted from' dithicarbonate-coated SWCNT were performed. The commercially available monomers (i.e. acrylonitrile, butyl acrylate, acrylic acid) as well as the new synthesized ones were used in order to obtain polymer-SWCNT nanohybrids. Raman spectroscopy, Fourier transform infrared spectroscopy (FT-IR), X-ray photoelectron spectroscopy (XPS), thermogravimetric analysis (TGA), and transmission electron microscopy (TEM) were employed to confirm modifications and study chemical composition of the obtained materials.

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