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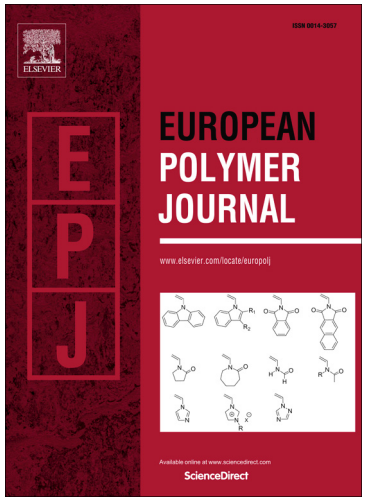

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Synthesis of high dispersible hydrophilic poly (ethylene glycol)/vinyl silane grafted silica nanoparticles to fabricate protein repellent polyethylene nanocomposite

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Abstract

Fabrication of protein repellent polymeric surface is a challenging issue for researchers in manufacturing biocompatible composites and low fouling membranes. In this study, poly (ethylene glycol) (PEG) and vinyl silane functional groups grafted silica nanoparticles (NPs) were synthesized by using one-pot/one-step sol-gel method. The fabricated NPs were dispersed in the high density polyethylene (HDPE) matrix to analyze the protein repellent property of HDPE sheets. FTIR results confirmed the successful grafting of both PEG and vinyl moieties on the silica NPs. TEM and DLS analyses showed that in the presence of both PEG and vinyl functional groups, the particles' sizes were reduced to about 10 nm. Dispersion of NPs in HDPE was obtained through blending in the presence of an initiator followed by the characterizations. The results obtained from backscatter electrons (BSE) images of HDPE nanocomposites revealed that PEG grafted silica NPs agglomerated in the HDPE matrix due to the lack of interaction between NPs and polymer molecular chains. However, dispersion of modified silica NPs was greatly improved in presence of vinyltrimethoxysilane (PEG/vinyl grafted silica NPs) due to the good compatibility between vinyl functional group of NPs and HDPE molecular chains. The contact angle of pure HDPE flat sheet sample was also reduced from 127 to 64 by adding 4% of PEG/vinyl grafted silica NPs due to the inherent hydrophilic characteristic of PEG. Static protein adsorption test showed that presence of vinyl moieties in the PEG modified NPs, significantly improved the percent reduction in protein adsorption, e.g. in case of 4 wt.% PEG/vinyl grafted silica NPs, it decreased from 0.0230 to 0.0012 mg/(ml.mm^2) (more than 94%).

Keywords: Silica nanoparticles, Poly (ethylene glycol), Vinyl silane, Hydrophilicity, Dispersibility, Protein repellent nanocomposite.