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The structure, property and biocompatibility of poly (butylene adipate-co-terephthalate)/cellulose whiskers nanocomposites prepared by reactive extrusion

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Cellulose whiskers (also known as cellulose nanocrystals) are unique rod-like nanomaterials derived from cellulose fibers which are the most abundant natural polymer. They have been the subject of extensive research efforts in the past decade due to their exceptional properties such as very high stiffness with an elastic modulus of a single crystal in the range of 100-150GPa, lower density compared to carbon or silica-based nanomaterials, bio-renewability and unique rheological and optical properties. Being a bio-based material; they have received significant attention for their potential use in tissue engineering and biomedical applications in conjunction with biocompatible polymers. However one of the challenges in the application of cellulose whiskers in polymer composites and nanocomposite is the difficulty of effectively dispersing these materials in polymer matrices especially non-water soluble polymers. This study reports on the development of a fully biocompatible poly (butylene adipate-co-terephthalate)/CNC nanocomposite prepared via reactive extrusion and investigation of the structure-property relationship in these systems. PBAT was first modified with maleic anhydride groups using an *in situ* melt extrusion process in order to promote the interfacial reaction with the surface hydroxyl groups of the CNCs. The nanocomposites are then prepared with up to 9% CNC in the following melt extrusion step. Analysis of the mechanical and thermal properties of these nanocomposites showed significant improvement in tensile strength, modulus and glass transition of the matrix. The 3D nanostructure of the CNC within the PBAT was studied by shear rheological techniques and the framework of scaling theory of fractal elastic gels. In vitro biocompatibility using Thiazolyl blue tetrazolium bromide (MTT) assay and cell adhesion studies with L929 fibroblast cells revealed no cytotoxic effect of CNCs while providing evidence for enhanced cell adhesion with the presence of cellulose nanocrystals in PBAT matrix.

Biography

Shahab Kashani Rahimi is currently a postdoctoral fellow in Prof. Joshua Otaigbe research group at the school of polymers and high-performance materials of the University of Southern Mississippi. He completed his PhD thesis under Prof. Otaigbe's supervision on developing a new technology to fabricate cellulose reinforced engineering thermoplastic composites using *in situ* ring-opening polymerization of cyclic monomers. He is currently working on graphene and nanofibrillated cellulose aerogels for deformation sensing and tissue engineering applications.

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