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Biopolymer nanocomposites based on poly(hydroxybutyrate-co- hydroxyvalerate) and WS2 inorganic nanotubes

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In recent years, special attention has been given to the benefits of polymer nanocomposite technology to improve the inherent properties of biodegradable polymers. These materials are called "bionanocomposites", and they provide a fascinating interdisciplinary research field that combines materials science, nanotechnology and biological science. The composites based on biodegradable polymers and different nanofillers with varying functionalities can lead to bionanocomposites with applications ranging from environmentally friendly packaging to automotive uses. Along with many interesting nanofillers, inorganic Transition Metal Dichalcogenide Materials (TMDCs), such as tungsten and Molybdenum Disulfides (WS2 and MoS2), are of interest to the scientific community because of their unique layered structure and functional properties, with nano-sized particles tending to exhibit a different set of properties compared to the bulk forms. TMDCs nanostructures can be zero-dimensional (0-D) (nanoparticles), one-dimensional (1-D) (nanotubes) or two-dimensional (2-D) (nanosheets). In particular, the use of environmentally friendly and biocompatible Inorganic Fullerene-like nanoparticles (IF-WS2) and nanotubes (INT-WS2) have been shown to offer design, processing, performance and cost advantages when compared to carbon nanotubes, nanoclays or other inorganic nanoparticles, for manufacturing advanced polymer nanocomposites. Incorporating of INT-WS2 into biopolymer can modify the crystallization behavior. The present research continues work in this field and focuses on the use of well-dispersed INT-WS2 for enhancing the processability and crystallization behaviour of poly(hydroxybutyrate-co- hydroxyvalerate) (PHBV) (Figure 1). In particular, the effects of different INT-WS2 loadings on the isothermal and non-isothermal crystallization behavior of PHBV were studied in detail, using neat PHBV for comparisons.

Recent Publications

1. Naffakh M, Marco C, Ellis G (2014) Development of novel melt-processable biopolymer nanocomposites based on poly(L-lactic acid) and WS2 inorganic nanotubes. Cryst Eng Comm 16:5062-5072.
2. Naffakh M, Díez-Pascual AM, Marco C, Ellis G, Gómez-Fatou MA (2013) Opportunities and challenges in the use of inorganic fullerene-like nanoparticles to produce advanced polymer nanocomposites. Progress in Polymer Science 38:1163-1231.
3. Naffakh M, Díez-Pascual AM (2014) Thermoplastic polymer nanocomposites based on inorganic fullerene-like nanoparticles and inorganic nanotubes. Inorganics 2:291-312.
4. Naffakh M, Díez-Pascual AM (2015) WS2 inorganic nanotubes reinforced poly(L-lactic acid)/hydroxyapatite hybrid composite biomaterials. RSC Advances 5:65514-65525.
5. Silverman T, Naffakh M, Marco C, Ellis G (2016) Morphology and thermal properties of biodegradable poly(hydroxybutyrate-co-hydroxyvalerate)/tungsten disulphide inorganic nanotube nanocomposites. Materials Chemistry and Physics 170:145-153.

Biography

Mohammed Naffakh obtained PhD in Physics from the Complutense University of Madrid (2001). He is "Ramón y Cajal" Senior Researcher at the Technical University of Madrid (ESTII-UPM). Before joining ESTII-UPM, he was a Postdoctoral Researcher at the Institute of Polymer Science and Technology (ICTP-CSIC, Madrid) (2005-2012) and the National Institute of Applied Sciences (INSA, Lyon) (2002-2004). His research interests are focused on the study of the structure-property relationship in polymer blends, composites, hybrid and nanocomposite materials. He has publications in Prog. Polym. Sci., J. Mater. Chem., RSC Adv., CrystEngComm, etc. He is member of the Educational Innovation Group "Materials Science and Engineering Education (MATERIALS-EDU)" at UPM.

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