Ricardo J. E. Andrade

Position: Assistant Professor

Affiliation: Mackenzie Presbyterian University / MackGraphe

Areas of interest: Rheology and processing of nanocomposites,
Colloidal Suspensions of 2D materials

Biography

Ricardo Jorge Espanhol Andrade was born in 1982, in Barreiro, Portugal. He obtained his B.S. degree in Polymer Engineering from University of Minho, Portugal, in 2005, and his M.S. in Formulation and Technology of Product from University of Huelva in Spain, in 2008. Furthermore, he was awarded a Fellowship from Portuguese Science and Education Ministry to pursue his PhD at Case Western Reserve University in Macromolecular Science and Engineering in Cleveland, USA, and finished in 2014. During his Ph.D. he worked on Polymer Rheology and Processing. Upon completion his Ph.D. work, he moved to a post-doctoral research position Institute of Electronic Structure and Laser of the Foundation for Research and Technology-Hellas (IESL-FORTH), Crete, Greece, where he worked until October 2015 on Colloids Rheology, more specifically on Shear Thickening Systems. He is currently Assistant Professor at Graphene and Nanomaterials Research Center (MackGraphe). His current research cover topics such as understanding the complex relationship between thermo-mechanical history and the structure and morphology of polymer nanocomposites based on 2D materials (graphene, MoS2, hBN, phosphorene, etc.). It is also part of his research the study of colloids dispersions of 2D materials under shear and extensional flows. His research intends to understand the fundamental mechanisms involved in the morphology and structure development of a polymer-2D nanocomposite, with the aim to improve their properties for broad range applications.

Rheology and processing of polymer nanocomposites with graphene and other 2D materials

Bi-dimensional (2D) nanomaterials became of great interest, scientific and technologically, due to their unique properties, after graphene was isolated in 2004. These unique properties make them extremely appealing to process polymer nanocomposites, due to their polymer-nanofiller interactions. These nanocomposites have been found to possess promising properties such as mechanical, barrier, thermal, and electrical. These properties are advantageous for applications in the field of food packaging, automotive, airplane, sport products, textile, electronic devices, membranes, and coatings/inks. Among the different methodologies of incorporate 2D nanofillers in a polymer matrix, melt blending is usually the most economical and industrial approach when compared with others. However, the effective reinforcement of polymers is still a challenge due to the poor dispersion and the strong interfacial adhesion between the nanofiller and the polymeric matrix.

In this study, we used different strategies to disperse 2D materials into polymer matrix by using a twin screw extruder. The influence of the methods, processing parameters, particles concentration, level of particles dispersion and polymer nanocomposite properties were evaluated with the aim to understand the thermodynamics and the physical-chemical interactions that are involved in the mixing and dispersion process, with special attention to the rheological properties. Actually, it was observed these particles have a significant influence depending on their preparation and pre-exfoliation, which influences the nanocomposites rheological behavior. Depending on their exfoliation level, they can behave as a lubricant, where the viscosity decreases with the particles. The results showed that the strategies used here to prepare polymer nanocomposite are very efficient in order to obtain a good dispersion, and consequently, obtention of a material with excellent properties at very low content (some cases less than 0.5% w/w).