Exploring the Impact of Silane Surface Modification on ZnO nanoparticles in the Wettability of PLA/Natural Wax Composites

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Meeting-report

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Nowadays, there have been a growing interest in the development of nanostructured materials with improved properties for various applications. Nanostructured polymers with metallic nanoparticles have received special attention due to the properties they present, giving potential for innovative applications in different fields. In this context, zinc oxide (ZnO) has been highlighted as a nanoparticle with physical and chemical properties, such as its high chemical stability, high radiation absorption range and high photostability. Furthermore, its size on the nanometer scale provides a large surface area and a high surface-to-volume ratio, which confers additional potential in interaction with other materials and their environment. Incorporating ZnO nanoparticles into a polymer matrix can provide improved properties and additional functionalities, taking advantage of both components.

For this reason, we created eco-friendly materials by combining biodegradable poly (L-lactic acid) (PLA), natural wax and ZnO particles. Particles were treated with Triethoxysilane and added in different concentrations of 0%, 0.1% and 1% by weight to an 85/15 PLA/natural wax (NWX) mixture using a special mixing process. Also the results with PLA/NWX/ZnO un-treated nanoparticles at same concentrations were compared to observe the effect of silane surface modification in the wettability of the composites. Wettability of the composites was determining by the water contact angle technique.

Morphology, size and compatibilization of ZnO nanoparticles were observed in a Transmission Electron Microscope TEM HITACHI 7700. Water contact angle was determined by a First Ten Angstroms, FTA 32 pendant drop equipment.

The synthesis of ZnO NPs the chemical co-precipitation method was used with slight modification of the Devi, P.G. and Ong C. B. et al procedure [1, 2]. For the functionalization of ZnO particles the procedure described by Idris, A. and coworkers [3]. Functionalized and un-functionalized particles were added in concentrations of 0%, 0.1% and 1% by weight to an 85/15 PLA/Natural Wax (NWX) matrix using a Brabender internal mixing at a temperature of 180 °C.

For PLA/NWX mixture the contact angle was around 75.2 °C, and the mixtures with ZnO particles treated with the Triethoxysilane it was observed, that the hydrophobicity of the mixture increased, reaching a maximum of around 85 °C for PLA/NWX/0.1%ZnO, making it less prone to absorbing water, Fig 2, which means the functionalized ZnO particles make the mixture more water resistant.

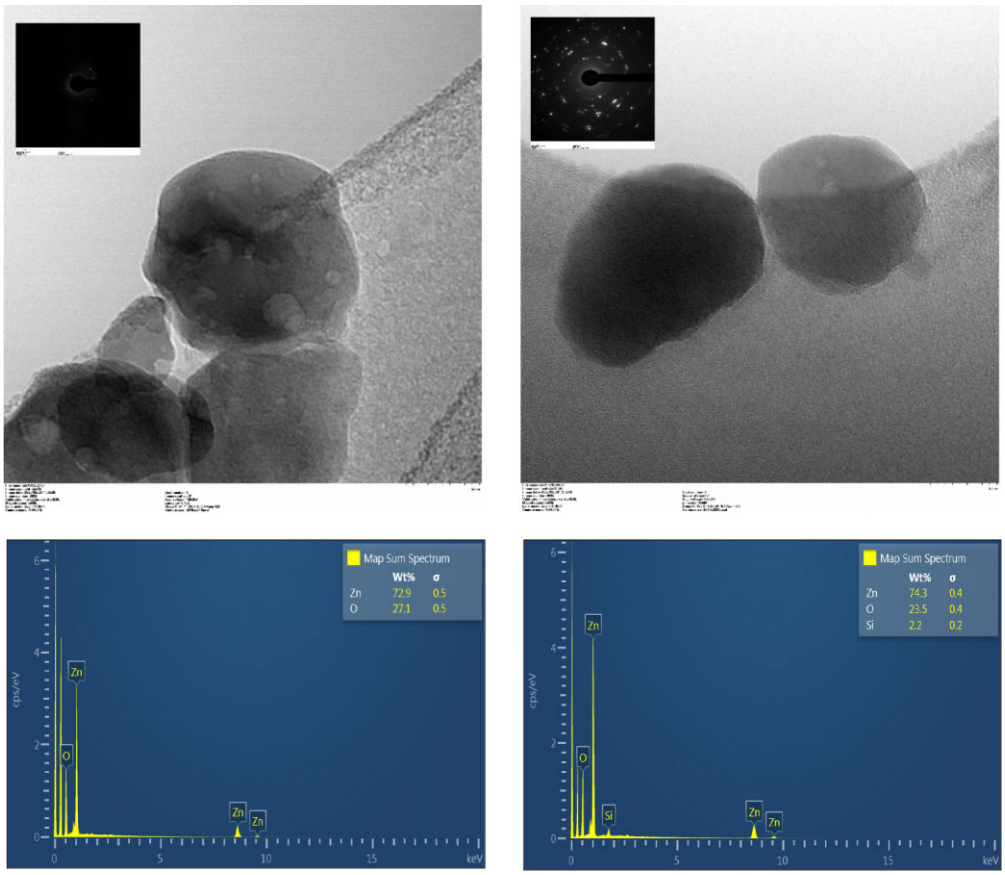

Fig. 1. Morphology and EDS of ZnO nano particles: (a) and (b) Un-functionalized, (c) and (d) Functionalized.

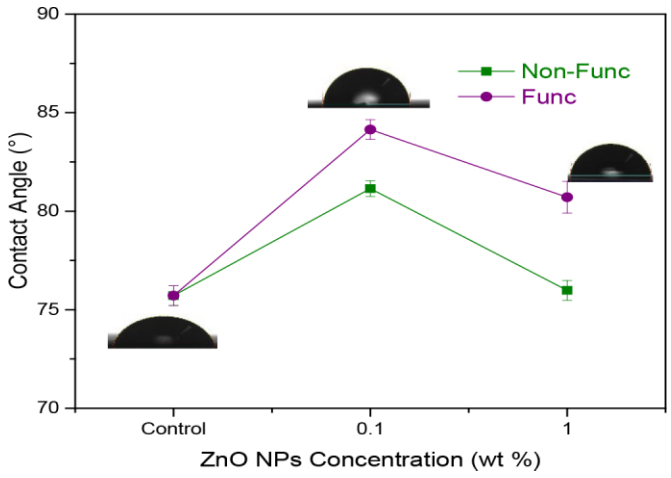

Fig. 2. Contact angle measurements for PLA/NWX/ ZnO nanoparticles funcionalized and non-functionalized.

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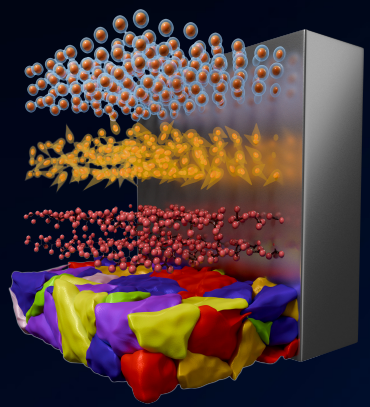

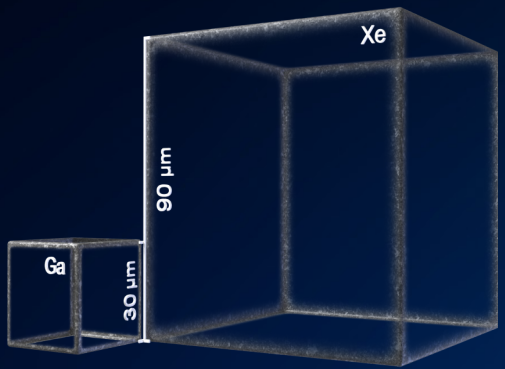

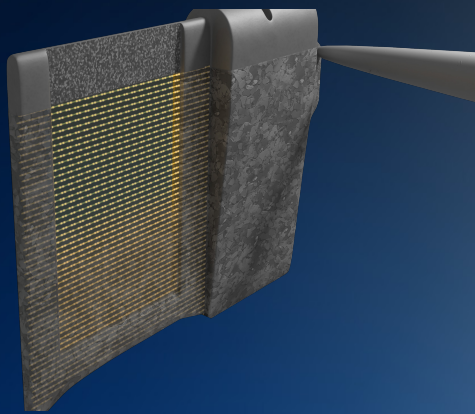

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