Poly-(L-Lactic Acid)-Imidazolium Borane Ionic Liquid / Graphene Nanocomposites as Potential Bronze Anticorrosive Films

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The involvement of materials science in the maintenance of monuments and historical artifacts is essential. Considering that most of the metal based monuments contain copper, which undergoes corrosive processes, this is expected to increase for the coming years.[1] This undesired reaction occurs at the bronze surface and can be attributed to the mechanism of degradation in which the main agent responsible is copper trihydroxychloride. The degradation's process starts after the interaction between copper and chloride ions, which are present in the soil or small dust particles.[2] Imidazolium salts (IS) species are reported to reduce this degradation, protecting the surface of the metal against the corrosion. Once imidazolium species are used, an interaction of the IS with the copper trihydroxychloride compounds takes place and inhibits the interaction of the copper trihydroxychloride with the surface of bronze monuments.[3] On the other hand, boron compounds which are well known to have antioxidative and antiwear properties. The incorporation of such a borane group in the imidazolium salt could provide a promissing candidate for an anticorrosive material.[4] In this work, a novel poly-(L-lactic acid) functionalized with 1-hydroxyethyl-3-methylimidazolium tetrafluorborate, containing graphene, was prepared as a potential anticorrosive material. This material was synthesized by the ring opening polymerization of the L-Lactide (LA), using the IS 1-hydroxyethyl-3-methylimidazolium tetrafluorborate as initiator, bounding the IS covalently to the polymer chain to form PLLA-IS. Finally, the PLLA-IS was mixed with reduced graphene oxide in a solution of chloroform to prepare, under evaporation of chloroform (solvent casting), PLLA-IS / Graphene nanocomposite films. The addition of graphene to the PLLA-IS increased significantly the mechanical property of the final material, increasing the storage modulus and the loss modulus at 30 ºC to 107% and 142%, respectively. Besides, the thermic resistance at $T_{50\%}$ increased 16 ºC. In conclusion, the synthesis of new polymeric nanocomposites, PLLA-IS / Graphene, increased the mechanical and thermic properties of the final material. Moreover, the presence of graphene on the surface of the nanocomposites turned it hydrophobic, which could difficult the sands to interact with water, preventing the formation of the corrosive copper trihydroxychloride compounds. As such, these nanocomposites have the potential for the protection of bronze-based materials against corrosion.

Key words: Polymer, Nanocomposites, Graphene, Anticorrosive Material, Nanotechnology.

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