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A ternary nanocomposite of alkyd/graphene oxide enriched with metal oxide nanorods as a robust coating material

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Abstract

Graphene oxide nanosheets decorated with one-dimensional metal oxide composites represent hotspot materials for designing sustainable vegetable oil-based nanocomposite coatings. In this paper, we have reported that graphene oxide nanosheets decorated with β–MnO_2 nanorods (GO/MnO_2 hybrid) were newly synthesized via a single step chemical deposition system. Linseed oil, which meets many principles of green chemistry, was used to design biobased alkyd matrix with hyperbranched moiety via a single-step polyesterification method. An advanced ternary nanocomposite series based on linseed oil alkyd filled with GO/β–MnO_2 NRs was developed via a solution casting technique, applied on carbon steel, and dried through an auto-oxidation mechanism. The structures, sizes and morphologies of designed polymeric nanocomposites and nanofillers were elucidated using various techniques such as FT-IR, NMR, XRD, FE-TEM, FE-SEM and XPS. Nano-GO with sheet-thickness < 2 nm as well as single-crystalline β–MnO_2 NRs with 20-30 nm mean diameter-size, < 1 µm length, and exposed with grown along [110] growth orientation of wurtzite structure were synthesized through controlled regimes. Surface heterogeneity, elasticity, non-wettability and corrosion-resistance features, are among the merits of developed composite. The synergetic effects of distributing different concentrations of GO/β–MnO_2 in the alkyd matrix were studied to tune the coating mechanical and protective properties. The coatings' mechanical durability and thermal resistivity were investigated using impact, mandrel bend, cross-hatch and abrasion tests as well as thermogravimetric analysis (TGA) technique. The surface and anticorrosion features of the ternary nanocomposites were studied through water contact angle, atomic force microscopy, scanning electron microscope, and salt-fog experiment (in 5% NaCl solution). The highest reinforcing improvement with thorn-like protrusions roughness was achieved through insertion of 2.5 wt. % GO/β–MnO_2 NRs fillers in the matrix. This fascinating biobased nanostructure coating provides a promising alternative for replacing petro-based anticorrosive coatings for the development of a sustainable future environment.

Biography :

Dr. Mohamed Selim is a postdoctoral scholar at the School of Chemical Engineering and Light Industry, Guangdong University of Technology, Guangzhou, 510006, PR China. He earned his B.Sc. (2006) at the Chemistry Department of Menoufiya University, Egypt and his M.Sc. (2012) in Organic Chemistry at the Faculty of Science of Menoufiya University, Egypt. He earned his Ph.D. (2015) in Polymer Technology and Materials Science at the organic Chemistry Department of Ain Shams University in Egypt. Since then, he has occupied different positions. He earned a Postdoctoral Scholar at the Technical Institute of Physics and Chemistry, University of Chinese Academy of Science, Beijing, China. He participated and attended numerous national and international events. He is a member in many scientific organizations and acts as a reviewer and referee in the field of anticorrosive paints, polymer technology and nanocomposites for different international journals and organizations

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