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Effects of Carbon Black/Graphite Ratio for Electrical Conduction and Frictional Resistance of Nanocomposite Sol-Gel Coatings

Authors : Julien Acquadro, Sophie Noel, Frédéric Houze, Philippe Teste, Pascal Chretien, Clément Genet, Edouard Breniaux, Marie-Joël Menu, Florence Ansart, Marie Gressier

Abstract : This paper presents the study results of the electrical and tribological properties of nanocomposite hybrid sol-gel coatings developed for industrial applications on electrical connector housings. The electrical properties of coatings are provided by conductive fillers. The coatings presented in this study are formulated with different types of conductive carbon fillers, in this case carbon black and graphite particles. The coatings are deposited on a high-phosphorous nickel substrate by a dip-coating process. The authors have investigated the effects of the carbon black/graphite ratio on the coating's electrical and tribological properties. Electrical characterizations with a 4-probe method and AFM measurements as well as tribological tests by micro-friction shed light on the role of the black carbon/graphite ratio on the final properties of the sol-gel nanocomposite coatings. This study shows that the amount of carbon black mainly drives the coatings' electrical conduction property, while graphite's lubrication properties bring interest to reduce the values of friction coefficients (at a contact pressure of 800 MPa). In the industrial field of electrical connectors, such coatings aim at replacing cadmium and chromium (VI) protection, as recommended by REACH (Registration, Evaluation and Authorization of Chemicals) and RoHS (Restriction of Hazardous Substances in electrical and electronic equipment) regulations (Annex XVII of REACH).

Keywords : carbon conductive fillers, electrical conduction, sol-gel coatings, tribology
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