Fabrication and characterisation of electro-brush plated nickel-graphene oxide nano-composite coatings

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Abstract

The extraordinary mechanical and anti-corrosion properties of graphene call for facile fabrication of graphene-based coatings with high uniformity and in large area. This research was aimed at exploring the use of an electro-brush plating technique for the production of graphene-metal nano-composite coatings. Graphene oxide (GO) was introduced into the nickel plating solution at varied concentrations and composite coatings were fabricated on stainless steel surfaces by brush plating under the same conditions. The morphology and microstructure of the obtained Ni-GO composite coatings were fully characterised and compared with neat Ni coating. The results confirm that GO sheets have been incorporated into the nickel matrix homogeneously, leading to a considerably reduced average crystallite size. Nanoindentation measurements demonstrated that GO can not only improve the hardness and reduce the plasticity of the composite matrix, but also enhance the thermal stability of the composite coating effectively. It has also been revealed by polarisation and electrochemical impedance spectroscopy (EIS) analysis that GO can increase the corrosion resistance of the composite coating owing to its barrier effect. However, it was also noticed that excessive GO content resulted in a degradation of both mechanical and corrosion properties, likely due to a more defective microstructure.

Key words: Graphene oxide; Nano-composite coating; Nanoindentation; Thermal stability; Electrochemical impedance

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