Anti-corrosion design of MOF-based nanocomposites enhanced epoxy coatings

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Abstract Organic epoxy coatings has emerged as one of the most commonly utilized methods to prevent aluminum alloys from losing their service value due to corrosion. However, during the curing process of organic coatings, hydrophilic groups and residues from certain additives can cause the formation of micro-pores and cracks, allowing corrosive materials to penetrate. This infiltration of hydrophilic corrosive media accelerates metal corrosion. To improve the corrosion resistance of epoxy coatings, the coating with passive and active protection has attracted a great interest in recent years. Using MOF-based nanocomposites as two-dimensional (2D) containers to load corrosion inhibitors is one of the most effective strategies. The containers not only enhance barrier property of the coating but also could control the release of corrosion inhibitors, which can offer active protection.

In this work, two-dimensional UiO-67 nanosheets are successfully modified on graphene oxide (GO). The synthesized GO@2D-UiO-67 composite not only exhibits the electrical insulation characteristics, but also leverages the passive barrier effect of its 2D layered structure to prepare a highly anticorrosive epoxy coating. Electrochemical measurements reveal that the impedance modulus of the GO@UiO-67/EP composite coating remain two orders of magnitude higher than that of the pure EP coating even after 28 days of immersion in 3.5 wt.% NaCl solution. This good long-term anti-corrosion performance could derive from the enhanced crosslinking density of composite coating due to the incorporation of GO@UiO-67 nanosheets. Furthermore, the shielding effect of layered structure and the corrosion inhibition behavior of organic ligands are proved to improve the corrosion resistance properties of composite coating. This research fills the application void of two-dimensional Zr-MOF composites in resin coatings, as well as serves as a forward-looking initiative to enhance the long-term corrosion protection of epoxy resin coatings.

Keywords: Zr-MOF, UiO-67, GO, Anti-corrosion, Epoxy coatings

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