Performance of functionalized graphene oxide to improve anti-corrosion of epoxy coating on 2024-T3 aluminium alloy

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HIGHLIGHTS

- Create a coating system with epoxy and functionalized graphene oxide (FGO) pretreatment.
- Aluminium activated by silane and graphene give the best results.
- FGO pretreatment layer formed covalent bonds with the top epoxy layer.
- FGO significantly improved the adhesion and corrosion resistance properties of the epoxy layer.

GRAPHICAL ABSTRACT
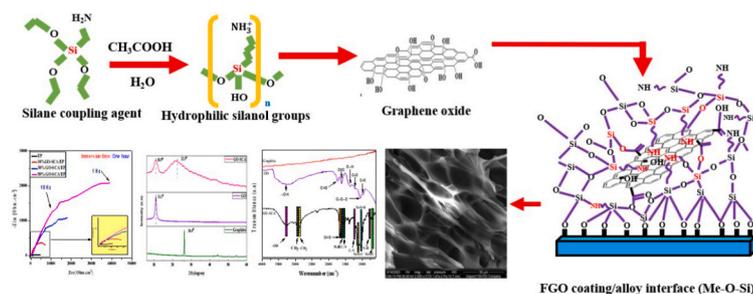
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ABSTRACT

Graphene has unique characteristics associated with being a trend of nanomaterials for manipulating the structure and improving the properties of materials for wide applications such as anti-corrosion. 3-amino-propyl-triethoxy-silane was dispersed in deionized water with acetic acid to prepare a 3-amino-propyl-triethoxy-silane coupling agent, then mixed with graphene oxide suspended in deionized water to produce functional graphene oxide pretreatment layer. The functional group was confirmed using Fourier transform infrared. It showed successful covalent bond formation between the amine and silanol groups of the silane coupling agent and the graphene oxide functional groups. X-ray diffraction and Field emission scanning electron microscopy results confirmed the graft of graphene oxide onto the surface of the silane. Functional graphene oxide pretreatment layers were used to treat 2420-T3 aluminium alloys using different loading ratios. The epoxy primer curing solution was added to the green epoxy primer coating and sprayed onto the functional graphene oxide placed on the activated aluminium alloy using the spray coating method. The corrosion resistance performance of the coating systems was evaluated using electrochemical tests. The results revealed improvements in the corrosion resistance for all graphene oxide-silane/epoxy coating specimens. Interestingly, a 50% graphene oxide-silane/epoxy coating system presented effective dispersion of graphene oxide and excellent compatibility with silane. It exhibited a significant improvement in the real impendence by up to 759% compared to other coating systems, and only 5% of the coating was removed during the adhesion analysis. The results confirm the corrosion protection of 2024-T3 aluminium alloy using functionalized graphene oxide coating and provide long life and eco-environmentally methods to protect metals and save the environment.