

Electrophoretic deposition of two-dimensional GO-MXene nanocomposite coating for corrosion prevention

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Abstract

Corrosion is a pervasive problem that can cause significant damage to metal surfaces, leading to reduced durability and increased maintenance costs. Therefore, finding effective ways to prevent or slow down corrosion is crucial in many industries. One promising solution to corrosion is the use of graphene reinforced MXene nanocomposite coatings. It represents a new class of two-dimensional coating material with improved functionality which will be in high demand because of its extraordinary mechanical, electrical, and anti-corrosive properties. In this study, we investigate the electrophoretic deposition (EPD) of 2D-nanocomposite (GMX) coating consisting of graphene oxide (GO) and $Ti_3C_2T_x$ MXene onto copper substrate. The stable colloidal suspension of GMX nanocomposite was prepared by dispersion of 1 wt% $Ti_3C_2T_x$ MXene and 0.1 wt% GO in NMP and water, respectively. The EPD process was optimized to achieve uniform deposition of the GMX nanocomposite coating. The effects of various deposition parameters, such as deposition time, voltage, and suspension concentration were systematically investigated to determine the optimal conditions for uniform coating formation with desired thickness. The SEM analysis reveals a homogeneous distribution of GO and MXene within the nanocomposite coating, indicating good compatibility between the two materials. The XRD analysis confirms the increase in d-spacing of the GMX sheets to 9.73 Å from 8.75 Å for neat GO sheets, which suggests that interlamellar insertion of MXene nanosheets into GO sheets has occurred. The FTIR analysis confirms the formation of Ti-O-C bond between MXene and graphene nanosheet via nucleophilic substitution reaction. The Tafel measurements exhibited excellent corrosion inhibition efficiency of 99.64% for the GMX coated copper in comparison to the bare substrate. Furthermore, the mechanical properties of the coatings, such as hardness are significantly improved, suggesting potential applications in wear-resistant coatings. These findings provide insights into the coating, highlighting their potential in corrosion protection.

References

- [1] Yujie Qiang, Boyuan Ran, Minjiao Li, Qian Xu, Jian Peng, *J Colloid Interface Sci*, 15 (2023) 595-603
- [2] Ali Zayaan Macknojjia, Aditya Ayyagari, Elena Shevchenko, Diana Berman, *Scientific Reports*, 13 (2023) 11057
- [3] N Usha Kiran, Ghritanjali Sahu, Sriparna Chatterjee, and Laxmidhar Besra, *Journal of Coating Technology and Innovation*, 2 (2024) 19-28

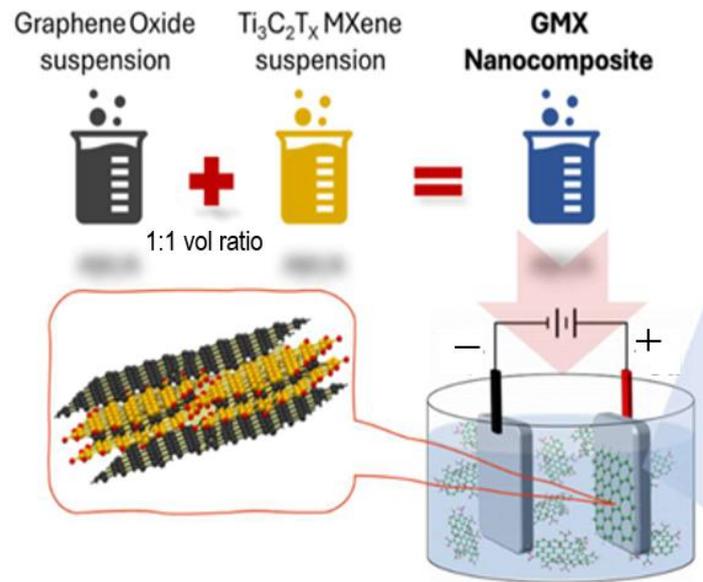


Figure 1: Schematic of GO-MXene composite coating by electrophoretic deposition