Advances in anticorrosion composite coatings

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Abstract: Corrosion poses a ubiquitous and costly challenge for diverse industries, primarily contributing to marine mechanical failures, metal degradation, service inefficiency and insecurity. To mitigate the almost 3.34% of gross domestic product losses attributed to corrosion in China, the lifespan of metallic structures, as the cornerstone of their design, is of paramount importance, as it determines their complete functional failure from the moment they enter service. Herein, drawing upon our previous researches, we capitalized on the potential of a pH-responsive switch on the surface of HNTs as the composite filler to precisely control the release of corrosion inhibitor under acidic, neutral, and alkaline conditions. It effectively impedes the permeation of corrosive media within the composite epoxy coating system, thereby inhibiting the progression of corrosion on the metal surface. The results specifically showed that after 63 d of immersion, the $|Z|_{0.01\ Hz}$ value of the composite epoxy coatings (containing 0.5 wt% composite filler) remained at 9.98×10^{9} ohm • cm^{2}, which was two orders of magnitude higher than that of the pure EP coatings, due to the multifunctional role played by the nanoparticles in active corrosion inhibition, anodic passivation and physical shielding. In conclusion, this study provides a potential strategy for formulating coatings with durable anticorrosive properties, offering promising prospects for industrial applications in harsh environments.

Keywords: pH-drive, smart nanocontainers, composite coating, corrosion protection.