

The construction of corrosion inhibition organic coatings via incorporating black phosphorene

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Abstract: Black phosphene (BPNS), as a novel 2D nanomaterial, in order to better utilise the advantages of its 2D lamellar structure, single-layer or few-layer BPNS materials were obtained by electrochemical intercalation and exfoliation, and BPNS@WEP composite coatings were prepared by using them as functional fillers. The SEM results showed that doping 0.2 % BPNS was able to disperse uniformly in the epoxy resin matrix and improve the film-forming process of WEP, thus reducing the defects such as micropores in the coating. The electrochemical impedance spectroscopy (EIS) results show that the impedance modulus value of the 0.2 % BPNS@WEP coating immersed in 3.5 wt. % NaCl solution for 40 d is still as high as $1.354 \times 10^7 \Omega \cdot \text{cm}^2$, which is an enhancement of about two orders of magnitude compared with that of the pure WEP coating ($2.557 \times 10^5 \Omega \cdot \text{cm}^2$), and exhibits excellent corrosion protection. In addition, the cone calorimetry test shows that the addition of 0.2 % BPNS reduces the total heat release (THR) and the peak heat release rate (PHRR) of WEP by 30.1 % and 40.2 %, respectively, which effectively improves the flame retardant properties of the composite coating. Finally, the study identified the corrosion products to reveal the anti-corrosion mechanism of the composite coating. This work also highlights the potential of BPNS as a dual-effect coating filler with efficient anti-corrosion and flame retardant properties.

Keywords: Black Phosphazene (BPNS); Waterborne Epoxy Coating (WEP); Corrosion Protection; Flame Retardant Properties