Hexagonal boron nitride nanomaterial to enhance the corrosion resistance of epoxy coated steel subjected to stress in simulated concrete pore solution

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Abstract Epoxy coating is one of the most popular anti-corrosion techniques in engineering structures under severe environments. Nevertheless, epoxy resin tends to exhibit low toughness, high brittleness, and poor mechanical properties. In this study, polydopamine (PDA) was used to modify hexagonal boron nitride (h-BN), addressing the poor dispersion of h-BN in epoxy. Layered double hydroxides (LDHs) of magnesium-aluminum intercalated with nitrite ions (MgAl-LDHs) were prepared by co-precipitation method. Tensile test results showed a significant improvement in the maximum tensile strength and elongation at break of PDA-h-BN/EP composite coatings compared to pure epoxy coatings. Corrosion studies of coated steel in simulated concrete pore solution under the simultaneous attack of loading and corrosive environment were conducted, with tensile stress of 0.3, 0.6, and 1 times the yield strength, respectively. The results showed that the applied stress had a significant impact on the coating performance, with higher loads leading to faster deterioration of the coatings. However, compared to pure epoxy resin, coatings modified with PDA-h-BN and h-BN@LDHs composite materials extended the coating failure time. This was mainly attributed to: (1) the addition of BN nanosheets lengthened the diffusion path of

the corrosive medium and improved the mechanical properties of the coating; (2) MgAl-LDHs, as corrosion inhibitors, effectively adsorbed chloride ions, preventing corrosion of the metal substrate, resulting in a synergistic effect between the two additives.

Keywords Epoxy composite coating; steel; corrosion resistance; simulated concrete pore solution