A Smart "Coat" for Metal Materials Against Acid Rain: Improvements on Traditional Metal Coatings

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Acid rain is a common air pollution problem in southern China. Its acid particles corrode metal structures, causing significant economic losses and safety hazards. Traditional organic polymer coatings only "passively" block the corrosive medium, and once the surface is defective, protection is very limited and corrosion will accelerate. Inspired by medical ideas about targeted drugs that can accurately treat diseases with acid response, I explored and developed a smart corrosion coating for "active" protection from acid rain. My experiments include two parts, synthesis and verification of new materials. Firstly, after screening the inhibitor type, concentration of inhibitor, and the ratio of the inhibitor to the original ligand, I selected 2-aminobenzimidazole as a corrosion inhibitor and loading material (ZIF, Zeolitic Imidazolate Framework). The optimal ratio of the original ligand was tested under different conditions, revealing 26% as the optimal loading ratio, which can achieve a uniform particle size of < 100 nM. Secondly, after adding this new material to the traditional organic epoxy coating, the adhesion and electrochemical impedance spectroscopy of the coating to the metal surface were tested. The results show that the smart coating enhances the resistance of the traditional coating to corrosive media. Under simulated acidic conditions, further experiments show that the smart coating was stimulated by the acidic environment when the surface was defective, and was "actively" released. After that, I visited a company that develops and produces acid-proof and corrosion-resistant coatings in Beijing, China. The engineers think my product is valuable and need further research before entering the market.