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Electrochemical aspects of the application of ZnAl layered double hydroxides (LDH) to corrosion protection

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Over the last two decades, corrosion protection research has increasingly focused on the development of inhibitor-loaded nano-reservoirs. These systems allow the incorporation of soluble corrosion inhibitors that would otherwise compromise the stability of paint matrices. The reservoirs can be engineered to release their contents selectively—triggered by the onset of corrosion or upon exposure to harsh environmental conditions—thereby conserving unused containers for prolonged protection. A clear example of such nano-containers is layered double hydroxide (LDH) particles, known for their anion-exchange properties. This unique capability has been applied in a wide range of fields, including trace chemical adsorption, catalysis, drug delivery, energy storage, and CO_2 capture. In corrosion protection, LDH particles can scavenge aggressive anions like chlorides and sulphates while simultaneously releasing protective anionic inhibitors.

This work explores the application of ZnAl-LDH in various corrosion protection strategies, such as embedding the particles in paints [1] or incorporating them into mortar and concrete to protect reinforcing steel [2]. Furthermore, aluminium and zinc substrates were treated to form LDH-based surface films, improving both corrosion resistance and paint adhesion [3]. the synthesis and characterization of these materials are detailed, alongside with the corrosion resistance evaluation using electrochemical methods like polarization curves, electrochemical impedance spectroscopy (EIS), and the scanning vibrating electrode technique (SVET).

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