

## The corrosion protection mechanism and application of layered double hydroxide (LDH) in coatings

**Yanhui Cao**<sup>1\*</sup>, Jingjing Wang<sup>1</sup>, Junhao Xue<sup>1</sup>, Congshu Huang<sup>1</sup>

<sup>1</sup>*Luoyang Ship Material Research Institute, National Key Laboratory of Marine Corrosion and Protection Xiamen, 361101, China*

*Presenter's e-mail address: yanhuicao@vip.163.com*

**Abstract** Layered double hydroxide (LDH) attracted world-wide attention from lots of researchers due to its anion containing property and anion-exchange characteristic in recent years [1-2]. Based on the above characteristics, LDH can be used as an intelligent pigment in the organic coatings. The corrosion protection mechanism and application of layered double hydroxide (LDH) in epoxy coatings was investigated systematically in this work. Firstly, the hydroxide layers and the interlayer space of LDH was adjusted by changing the metal ions, synthesis temperature, synthesis time and reactant concentration etc. The result indicated that although ZnAl-LDH presented larger chloride capacity than that of MgAl-LDH and CaAl-LDH, CaAl-LDH exhibited better corrosion protection ability than the other two LDHs in the coatings. The underlying reason was that CaAl-LDH have better compatibility with the epoxy coatings and it could demonstrate better physical barrier effect. Furthermore, inorganic inhibitors including nitrites and molybdates were used to modify CaAl-LDH and the result indicated that the layered structure was destroyed in the immersion of Na<sub>2</sub>MoO<sub>4</sub> solution due to the formation of CaMoO<sub>4</sub>. The nitrite-intercalated CaAl-LDH presented superior corrosion protection for the carbon steel in epoxy coatings. This work provided inspiring insight into the selection of inorganic inhibitors that precipitates should not be formed between LDH and the inhibitors. Finally, aromatic organic inhibitors including 2-mercaptobenzothiazole (MBT), sodium benzoate (BZ), benzotriazole (BTA) also have been adopted to modify LDH. The electrochemistry impedance spectroscopy (EIS) measurement demonstrated that CaAl-LDH-MBT showed superior protection for carbon steel in epoxy coatings. Density functional theory (DFT) calculation and molecular dynamic (MD) simulation indicated that the aromatic conjugated structure with larger  $\pi$  electron clouds and heteroatoms with lone pair electrons would contribute to the enhanced corrosion protection. This could shed light on the selection and design of organic inhibitor in the future modification of layered double hydroxides for corrosion protection.

**Keywords** layered double hydroxide, corrosion protection, coatings

**Reference**

- 
- [1] Yanhui Cao et al. Journal of Materials Science & Technology 102 (2022) 232–263.
- [2] Jingjing Wang, Yanhui Cao\* et al. Corrosion Science 231 (2024) 111994.