Release behavior of antifouling materials based on intercalated layered double hydroxides

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Abstract Improving the utilization rate of environmentally friendly antifouling agents is highly important for reducing the economic costs of ship operations and protecting the marine environment. In this work, a new method for preparing a multistage controlled release material of an environmentally friendly antifouling agent, which first incorporates 2-(p-chlorophenyl)-3-cyano-4-bromo-5-trifluoromethyl pyrrole (Econea) into carboxyl-modified *β*-cyclodextrin (Econea@CMCD) followed by intercalation into Mg_2Al layered double hydroxides (Mg_2Al-Econea@CMCD-LDH), was reported. Powder X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FT-IR) confirmed the incorporation of Econea@CMCD into the galleries of Mg_2Al-LDH. Release tests conducted in 3.5% NaCl solution demonstrated an initial burst release, followed by a slower release rate of Econea (12.3 μg/cm^2·d) compared to that of the pristine Econea coating, indicating favorable controlled release behavior. Adhesion experiments using diatoms and mussels showed that Mg_2Al-Econea@CMCD-LDH effectively inhibited the adhesion of typical fouling organisms. Hence, this study presents a practical approach for constructing a controlled release system that involves intercalating neutral and insoluble antifouling agents into LDH interlayers, effectively reducing the waste of antifouling agents and extending the service life of antifouling coatings.

Keywords layered double hydroxide; Econea; composite materials; thick films; controlled release; antifouling properties

Reference

[1] D. Liu, H. Shu, J. Zhou, et al., Biomimetics (2023) 8020200.
[2] X.X. Hao, X. Zhang, W.J. Wang, et al., Progress in Organic Coatings 189 (2024) 108208.
[3] X. Liu, M. Wei, X. Duan, et al., Chemical Engineering Science 64(9) (2009) 2226-33.