Study on the failure mechanism of organic silicone fouling release coatings in marine environment

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Abstract Organic silicone fouling release coatings have attracted attention from countries around the world due to their superior environmental friendliness and long-term effectiveness, and have become an important development direction for ship antifouling materials. In the development of antifouling coatings, formula screening and antifouling performance evaluation are important steps, and the establishment of evaluation methods for fouling release coatings in marine environments is supported by the failure mechanism.This study conducted a 2-year real sea immersion test on the fouling release coatings, and systematically obtained the changes in key antifouling characteristic parameters such as coating surface energy, surface chemical groups, and surface roughness over time. The surface roughness and surface energy of the coating gradually increased, while the peak height ratios of methyl-siloxane groups gradually decreased. Through infrared spectroscopy, Raman spectroscopy, X-ray photoelectron spectroscopy, and MAS NMR analysis, the failure mechanism of organic silicone fouling release coatings in real sea was explored. In seawater environment, the surface methyl of the coating is gradually oxidized to methylene, and the silicon element transitions from the Si - $(O)_2$ state to the inorganic Si - $(O)_4$ state, gradually becoming inorganic. There is also an adhesion and friction effect between sea sand and marine organisms. Coating failure is mainly caused by the gradual aging (oxidation) and wear of materials in seawater environment, leading to degradation and imbalance of antifouling characteristic parameters. This study provides a new theoretical basis for the performance evaluation of organic silicone fouling release antifouling coatings.

Keywords Fouling release coating, failure mechanism, marine environment

Reference

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