

10、 Marine Biofouling and Protection Technologies

Surface Reconstruction of Silicone-Based Amphiphilic Polymers for Mitigating Marine Biofouling

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Abstract Poly(dimethylsiloxane) (PDMS) coatings are considered to be environmentally friendly antifouling coatings. However, the presence of hydrophobic surfaces can enhance the adhesion rate of proteins, bacteria and microalgae, posing a challenge for biofouling removal. In this study, hydrophilic polymer chains were synthesised from methyl methacrylate (MMA), Poly(ethylene glycol) methyl ether methacrylate (PEG-MA) and 3-(trimethoxysilyl) propyl methacrylate (TPMA). The crosslink-ing reaction between TPMA and PDMS results in the formation of a silicone-based amphiphilic co-network with surface reconstruction properties. The hydrophilic and hydrophobic domains are covalently bonded by condensation reactions, while the hydrophilic polymers migrate under water to induce surface reconstruction and form hydrogen bonds with water molecules to form a dense hydrated layer. This design effectively mitigates the adhesion of proteins, bacteria, algae and other marine organisms to the coating. The antifouling performance of the coatings was evaluated by assessing their adhesion rates to proteins (BSA-FITC), bacteria (*B. subtilis* and *P. ruthenica*) and algae (*P. tricornutum*). The results show that the amphiphilic co-network coating (e.g., P-AM-15) exhibits excellent antifouling properties against protein, bacterial and microalgal fouling. Furthermore, an overall assessment of its antifouling performance and stability was conducted in the East China Sea from 16 May to 12 September 2023, which showed that this silicon-based amphiphilic co-network coating remained intact with almost no marine organisms adhering to it. This study provides a novel approach for the development of high-performance silicone-based antifouling coatings.

Keywords silicone-based, amphiphilic, surface reconstruction, hydration layer, antifouling

Reference

[1] Wei, C.; Zhang, Y.; Tang, Z.; Zhang, C.; Wu, J.; Wu, B. Surface Reconstruction of Silicone-Based Amphiphilic Polymers for Mitigating Marine Biofouling. *Polymers* 2024, 16, 1570.