A rationally designed polymer brush/lubricant coating system for effective static and dynamic marine antifouling

Baoxin Wang[1], Hongxing Ye[1], Baiyi Chen[1], Jianhua Wu[1]

[1]*Marine Engineering College, Jimei University, Xiamen 361021, PR China*

wangbx@jmu.edu.cn

Abstract Bioinspired slippery surfaces have garnered significant attention as promising solutions to mitigate biofouling. Unlike traditional lubricant-infused porous surfaces, recent research has focused on the integration of lubricants within polymer brush-grafted surfaces. The combination of polydimethylsiloxane (PDMS) polymer brush and silicone oil has gradually become the most prevalent choice due to their outstanding chemical affinity. However, this conventional coating system also has the potential for improvement to meet the needs of long-lasting and efficient marine antifouling, including i) precisely designing the polymer brush's chemical structure to match the polarity of a specific lubricant enhances their chemical affinity, and ii) appropriately reduce the coating system's surface energy to improve the fouling desorption performance. Here, we introduce a systematically engineered polymer brush/lubricant coating system that incorporates fluorinated polysiloxane and perfluoropolyether fluid. This novel coating system exhibits enhanced adhesion strength coupled with reduced surface energy, resulting in superior stability and omniphobic properties. Additionally, it showcases excellent corrosion resistance and significantly deters marine microorganism adhesion, achieving reductions of 98.8% for *P. tricornutum* and 99.8% for *Bacillus sp.*. Marine field trials, conducted over a 90-day static immersion period, confirm the remarkable antifouling performance, which surpasses most existing slippery coatings. Moreover, under dynamic conditions, organisms adhering for 150 days are readily dislodged by shear force. These findings underscore the pivotal role of systematic design in polymer brush/lubricant coating systems for the advancement of high-performance slippery surfaces tailored for marine antifouling applications.

Keywords Marine antifouling; Liquid-like polymer brush; Slippery surface; Liquid repellency

Reference

[1] B. Wang, H. Ye, B. Chen, P. Zu, G. Lu, L. Ma, H. Zhang, M. Sun, Y. Li, H. Liu, J. Wu, A rationally designed polymer brush/lubricant coating system for effective static and dynamic marine antifouling, Chem. Eng. J. 495 (2024) 153568.