Thermodynamic analysis of diatom *Navicula pinna* attachment to microtopographies

Jinwei Zhang, Zhi Li, Li Wang, Jiyong Zheng, Cunguo Lin

National Key Laboratory of Marine Corrosion and Protection, Luoyang Ship Material Research Institute, Qingdao 266101, China

Abstract Biofouling formation on the surfaces of ship hulls can bring about some unwanted and detrimental consequences, which has been recognized as a widespread problem. Toxic compounds, such as copper-based antifoulants, can prevent the happening of biological fouling, but they have negative impacts on non-target organisms and lead to detrimental ecological effects. Environmental concerns and legislation require developing new eco-friendly fouling-resistant technologies to replace toxic antifoulants. Recently, It was found that microtopographies of pillars, triangles/pillars, ridges and Sharklet AF^{TM} could reduce the attachment of *Ulva* spores and *Cobetia marina*, and that hierarchical wrinkled surface topographies could resist biological fouling even after 18 months field test. It may be useful in the designing of more powerful antifouling microtopographies if we can correctly predict microbial adhesion on regular microstructures. In this paper, six well-defined microtopographies were applied to prevent *N. pinna* attachment, and thermodynamic method was used to predict cells adhesion. Diatom attachment assay showed that the cells density was reduced significantly on all microtopographies compared to the smooth surface, and the relative attachment density of *N. pinna* had a reciprocal-proportional relationship with the free energy of adhesion (ΔG_{adh}). Historical data also showed that the thermodynamic parameter ΔG_{adh} is reliable to correctly predict *Cobetia marina* attachment to microtopographies, and the cell relative attachment density has a negative proportional correlation with ΔG_{adh} too. Because thermodynamic approach can be used to calculate ΔG_{adh} for cell attachment to regular and irregular surfaces, it may be widely used to design new antifouling materials.

Keywords

Microtopography, Surface energy, Thermodynamics, *N. pinna*, *C. marina*

Reference

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