Characterization, Replication and Testing of Designed Micro-Textures, Inspired by the Brill Fish, Scophthalmus rhombus, for the Development of Bioinspired Antifouling Materials

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Abstract : Growing concern about the natural environment has accelerated the search for non-toxic, but at the same time, economically reasonable, antifouling materials. Bioinspired surfaces, due to their nano and micro topographical antifouling capabilities, provide a hopeful approach to the design of novel antifouling surfaces. Biological organisms are known to have highly evolved and complex topographies, demonstrating antifouling potential, i.e. shark skin. Previous studies have examined the antifouling ability of topographic patterns, textures and roughness scales found on natural organisms. One of the mechanisms used to explain the adhesion of cells to a substrate is called attachment point theory. Here, the fouling organism experiences increased attachment where there are multiple attachment points and reduced attachment, where the number of attachment points are decreased. In this study, an attempt to characterize the microtopography of the common brill fish, Scophthalmus rhombus, was undertaken. Scophthalmus rhombus is a small flatfish of the family Scophthalmidae, inhabiting regions from Norway to the Mediterranean and the Black Sea. They reside in shallow sandy and muddy coastal areas at depths of around 70 – 80 meters. Six engineered surfaces (inspired by the Brill fish scale) produced by a 2-photon polymerization (2PP) process were evaluated for their potential as an antifouling solution for incorporation onto tidal energy blades. The micro-textures were analyzed for their AF potential under both static and dynamic laboratory conditions using two laboratory grown diatom species, Amphora coffeaeformis and Nitzschia ovalis. The incorporation of a surface topography was observed to cause a disruption in the growth of A. coffeaeformis and N. ovalis cells on the surface in comparison to control surfaces. This work has demonstrated the importance of understanding cell-surface interaction, in particular, topography for the design of novel antifouling technology. The study concluded that biofouling can be controlled by physical modification, and has contributed significant knowledge to the use of a successful novel bioinspired AF technology, based on Brill, for the first time.

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