

Smart Nano-surfaces for Biosensor and Biomedical Applications

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Nature abounds with mysterious biological creatures and organisms that exhibit unique surface wettability, such as lotus leaves with the self-cleaning property, rice leaves and butterfly wings with directional adhesion property, the mosquito eyes with antifogging functionality, and the Namib desert beetle and spider silk with water collection ability. Among the special wetting properties, anti-biofouling surfaces with liquid repellent properties have received considerable attention as they have various applications including self-cleaning fabrics, anti-fogging windows, drag reduction, and water transportation. In particular, in-situ manipulation of wettability and adhesion by engineering chemical or structural properties of anti-biofouling surfaces opens emerging biomedical applications where minimal liquid-substrate/cell-substrate interaction is required.

Here, we present a novel and facile method to fabricate smart anti-biofouling surface with switchable and controllable wetting property. Newer and emerging biomedical applications using the developed smart nano-surfaces, such as stem cell differentiation, RNA transfection, drug delivery, and multiplex biomolecule detections are introduced. In addition, we briefly introduce novel bioreactors that can apply electrical and mechanical stimuli on cells to study synergetic effects of static and dynamic micro-environmental factors on tissue behaviors for therapeutic applications