

Switchable Surface

Background

“Stimuli-responsive” or “smart” materials are defined as synthetic materials that experience dramatic changes in physical and/or chemical properties when subjected to small environmental influences. These switchable surfaces have biomedical applications and can be created through the use of a single layer of molecules that spontaneously form on a surface. Surface switching typically occurs in response to environmental changes or chemical reactions which limits use.

Technology

Switchable surfaces researched in this lab change their arrangement in space in response to an external electrical stimulus. In order for these shape changes to occur, sufficient spacing is needed between the monolayer molecules and thus a low density self-assembled monolayer (LDSAM) was created. This increased spacing is achieved by using a molecule that has a large head group. The headgroup maintains sufficient spacing between the molecules as they form on the object surface. Once the monolayer is formed, the large headgroup is removed permitting a change in the molecular spatial arrangement. The application of a weak electric field causes the top of the molecule, which is negatively charged, to bend into a loop shape as it is attracted to the positively charged surface (Figure 1). Before the application of the electric field, the monolayer is in a water-attracting state but after this application, it is in a water-repelling state. Removal of the field, returns the water-attracting behavior of monolayer, therefore, the properties of the surface can be reversibly switched. This is a novel platform because it allows for the creation of a “stimuli-responsive surface” without having to change the chemical environment and allows for a small scale change to have an impact on a large scale surface property.

Applications

- Biomedical diagnostics
- Cell adhesion/motility studies
- Tissue engineering
- Drug delivery

Advantages

- External stimulus
- Reversible/Tunable surface properties
- Shape/conformation changing
- Constant chemical environment

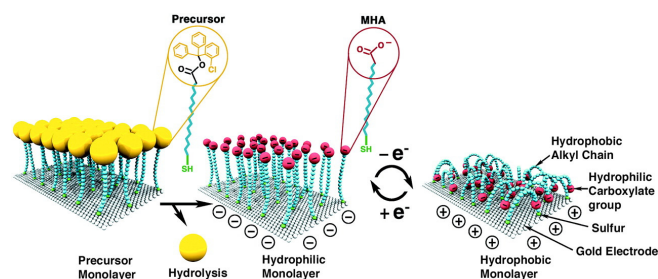


Figure 1: Switchable monolayer changing from water-attracting to water-repelling state

Publications

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- D.K. Peng, A.A. Ahmadi, J. Lahann. *Nano Letters* **2008**, 8(10), 3336-3340.
- D.K. Peng, S.T. Yu, D.J. Alberts, J. Lahann. *Langmuir* **2007**, 23, 1, 297-304.
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Patents

- J. Lahann, S. Mitragotri, R. Langer. "Switchable Surfaces", US patent, **2001**.