Protein Nanopatterning For Studying Cell Adhesion

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The interaction of the cells with its surroundings is mediated at the molecular and macromolecular level. Specific interaction with the extracellular matrix components or macromolecules in the membrane of adjacent cells provides signaling and communication pathways.[1, 2] These interfaces have both topographic nanostructure and chemical interaction site distributed at the nanoscale.[3]
Protein nanopatterns with lateral ordering between independent ligands and controlled lateral mobility has been made by using a nanoscale chemical contrast of Au patches in SiO2 by colloidal lithography. The nanostructured surfaces are made by depositing a triple polyelectrolyte layer at Au substrates. Latex particles self assemble at the surface governed by electrostatic forces followed by SiO2 evaporation and removal of the particles.[4] The short range ordered arrays of modified Au patches creates protein adhesive domains while the SiO2 becomes protein rejecting by adsorption of PLL-PEG. Addition of a fibronectin solution generates a protein nanopattern where protein binds to the hydrophobic regions.[5] Cell attachments are observed from small patches and the interaction of the cells with the protein pattern nanostructures is controlled by the size of protein patches. The cellular processes seems to be dependent on the spatial distribution of proteins on nanoscale as focal adhesion are missing at small patch sizes while increasing the patch size result in development of more elongated focal adhesions. The protein patterning makes it possible to limit the length of developing focal adhesions to single patches and hence alter the cells ability to generate forces, spread and move.

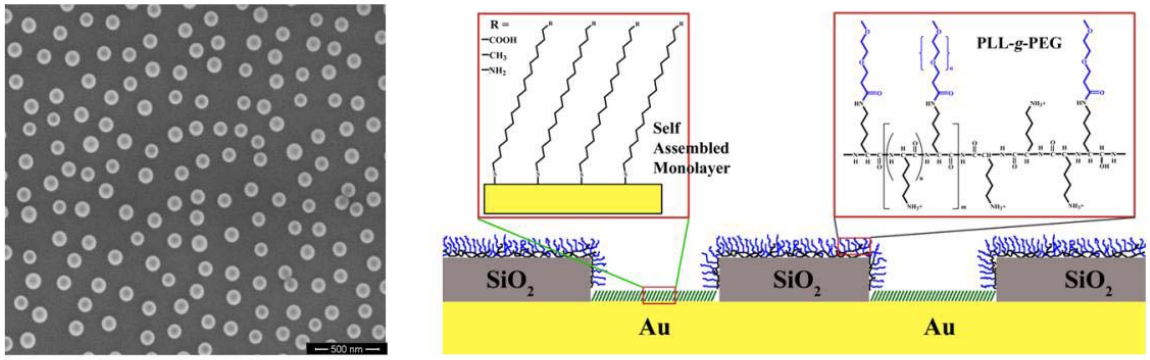

Fig. 1: (a) Nanostructured surface made by colloidal lithography; (b) The nanopatterned substrate are modified by thiolation of Au holes and PLL - PEG are adsorbed onto the SiO2 patches.

[1] Geiger, B. et al, Nat. Rev. Mol. Cell Bio., 2001, 2, (11), 793-805
[2] Geiger, B. et al Nat. Rev. Mol Cell Bio., 2009, 10, (1), 21-33
[3] Teixeira, A. I. et al. JVST B, 2003, 21, (2), 683-687
[4] Hanarp, P. et al., Colloids and Surfaces A, 2003, 214, (1-3), 23-36
[5] J. Malmstrom et al, Nano Letters, 2010, 10, (2), 686-694.