UNIVERSITY of WASHINGTON

Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

POSTER SESSION 3

Commons East, Easel 55

2:30 PM to 4:00 PM

Single Step Fabrication of Patterned Gold Film Array by an Engineered Multi-Functional Peptide

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EIP Scholar, McNair Scholar

Mentor: Marketa Hnilova, Materials Science & Engineering

The fabrication of nanoparticles in an array structure with specific geometries is critical for a variety of nano- and micro-technologies ranging from electronics to photonics. Metallic nanoparticles arrays organized on surfaces as a thin film are particularly promising for construction of sensing devices and systems. Although there are current methods in which control of nanoparticle pattern can be achieved, many come with harsh draw backs that range from high cost to the use of toxic chemicals that limit medical applications. This project focuses on a combined biological and material engineering approach to develop a bio-enabled fabrication method to control the nanoparticle arrays with desired geometry. Our research uses bi-functional quartz- and gold-binding peptide sequences (AuBP-QBP) to create gold patterns using soft lithography and self-assembly techniques. The multi-functionality of the peptide as well as its organic nature enable the peptide to self-assemble on the quartz surface within a short time while the assembled biomolecule provides the control of the gold nanoparticle array geometry within the desired structures. Overall, the gold thin film arrays are achieved under aqueous environment via single step bio-assembly process. Our evidence of the desired pattern control is verified by various microscopy techniques that include Dark Field Microscopy, Atomic Force Microscopy, and Scanning Electron Microscopy. The results of our research will contribute to develop metallic thin films arrays using a simple biologically relevant method in a controlled pattern. Future applications of this project will include developing variety of patterns having different nanoparticles size and shapes to follow various cellular and biomolecular responses on solid substrates.

POSTER SESSION 4

Commons East, Easel 73

4:15 PM to 5:45 PM

Antibody Binding Peptide Construct Assembles on Gold Surfaces through BioFunctionalization

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Mentor: Candan Tamerler, Materials Science & Engineering

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Conventional methods of biomolecular immobilization on metal surfaces entail surface functionalization by chemically prepared self-assembled monolayers (SAMs) conjugated with the desired biomolecules. Many such methods require multistep reactions under harsh environments, lack material selectivity, have low biomolecule coupling efficiencies, and often result in random-orientation during the adsorption of target biomolecules. Furthermore, the behavior and the stability of these synthetic molecules under physiologic conditions are still not well understood. During the last decade, bio-functionalization of surfaces using material binding peptides has been demonstrated to avoid such limitations. These peptide-based biomimetic approaches were demonstrated to functionalize surfaces on a variety of materials under aqueous environments. They offer a promising alternative to conventional chemical surface functionalization techniques, while providing the additional advantage of material specificity that chemical-based linkers lack. Further bioconjugation with functional biomolecules to the materials binding peptides provides the self-assembly of the conjugated product on the material surface in a single step. Here, we design a peptide exhibiting a strong binding affinity to gold substrates while immobilizing antibodies on the surfaces. Biocombinatorily selected gold-binding peptides (AuBPs) were conjugated to an antibody-binding domain (FcBP). The binding characteristics of the resulting constructs, i.e. AuBP-FcBPs, on gold substrates were evaluated using Surface Plasmon Resonance (SPR) spectroscopy. The coupling of different peptide functional domains into a single fused peptide has the risk of inducing structural changes in the resulting molecule due to intermolecular interactions. It is therefore critical to determine whether functionality of each region was maintained. The SPR experiments were carried out at different concentrations and resulted in Langmuir adsorption behavior, allowing the calculation of the binding constants. The

resulting bi-functional bioprobe molecule can be employed in a wide range of diagnostic and therapeutic applications.