Fabrication of Biomolecular and Polymeric Nanostructures by Proximal Probes

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In the past year the Duke NIRT team has made significant progress in the development of new nanomanufacturing processes. These include the following achievements:

(1) Development of a generic, modular approach to biomolecular lithography based on **nanoscale, covalent patterning of biotin** onto alkanethiol self-assembled monolayers (SAMs) on gold [1]. This approach enable the facile patterning of any biomolecule that can be synthesized as a biotin conjugate by a simple incubate and rinse procedure.

(2) The **first demonstration of the *in situ* fabrication of stimuli responsive polypeptide nanostructures** [2]. We have demonstrated that a genetically engineered stimuli responsive Elastin-like polypeptide (ELP) can be nanopatterned by DPN and that these biopolymer nanostructures exhibit a "smart" hydrophilic-hydrophobic phase transition at the surface. ELP nanopatterns with feature sizes ranging from 200 nm to 2.5 μm were fabricated by this method on gold surfaces. We also demonstrated that these smart nanostructures could reversibly bind a target protein of interest from solution by triggering the phase transition of the ELP on the surface. Nanopatterning with stimulus-responsive -smart- biopolymers holds significant promise for the fabrication of devices for biotechnology applications that require the capture of a target protein directly from a complex mixture and for devices where the transport, separation and detection of many biomacromolecules must be performed in aqueous solutions, with applications in biosensors and proteomic chips, and nanofluidic devices.

(3) The **first demonstration of surface-initiated nanopolymerization (nanoSIP)** using an atom-transfer radical initiator that is covalently nanopatterned on a gold surface by DPN [3]. Two different polymers have been successfully grown, *in situ* from a gold surface using this method; a protein and cell-resistant poly(oligoethylene glycol methacrylate) and a stimuli-responsive poly(N-isopropylacrylamide). The combination of DPN with SIP is an important enabling nanotechnology for nanomanufacturing, because it provides a new capability in the *in situ*, bottom-up fabrication of polymeric nanostructures, which are likely to be critical components of many nanoscale devices.

References

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