ATOMIC FORCE MICROSCOPY FOR NANOTECHNOLOGY

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ABSTRACT

The long-term goal of the Center for Affordable Nanoengineering of Polymer Biomedical Devices (CANPBD), a National Science Foundation Nanoscale Science and Engineering Center (NSEC), is to create a nanofactory based on the integration of biomolecules with polymer surfaces[1]. This nanofactory would have the capability of producing significant quantities of well-defined, multifunctional polymer-biomolecule conjugates to serve as nanoscale sensors, probes, actuators and reactors. Functional polymers, biomolecules (genes, proteins, lipids) and nanoparticles appropriately interfaced and patterned on polymeric surfaces will serve as building blocks for creating multiscale and multifunctional structures/devices.

Atomic force microscopy (AFM) is an indispensable technique for the creation of nanofactories as outlined in CANPBD via its three specific capabilities. **(a) Imaging**: AFM is a high-resolution (lateral~1nm, vertical resolution~0.1 nm) microscopy technique, which also enables imaging in a fluid environment. AFM thus avoids artifacts due to drying and/or coating of samples and can maintain biological molecules in near-physiological conditions. These characteristics make AFM an ideal technique for surface characterization and single-molecule microscopy[2]. **(b) Nanomanipulation:** the AFM tip can also be used to investigate mechanical and chemical forces at the nanoscale level by pulling a molecule in the vertical 'z' direction and measuring forces exerted on the tip[3]. Such an approach will be used to stretch DNA molecules and modify them at specific locations. Secondly, the dip-pen nanolithography (DPN) technique will be employed in the tapping mode of AFM to pattern (write-on) soft polymer and lipid surfaces at the nanoscale level[4-5]. **(c) Detection:** using specialized modes of AFM such as magnetic or electric force microscopy, we are working to detect and spatially localize trapped nanoscale magnetic (or electric) domains inside biological/polymer surfaces[6]. The approach consists of using magnetically coated AFM tips, scanning them at defined heights above the sample, and recording tip deflections. Application of an external magnetic field in the AFM setup will further help confirm the magnetic properties.

These approaches are being used/developed for specific collaborative CANPBD projects and an overview will be presented.

References

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