Interdisciplinary Biosciences

Student Seminar

Tuesday, May 28th at 12:00 p.m.

Room 700, Fairchild Hall

Pizza will be served at 11:45 a.m. outside 700 Fairchild

Duckhoe Kim

Sahin Laboratory

Department of Biological Sciences

Angstrom-Scale Chemical Microscopy with Single-Molecule Mechanical Measurements

We have developed a special microscope capable of generating chemically-specific multicolor images of biomolecules with sub-nanometer resolution. Our approach relies on detecting interaction forces between a specially designed probe DNA and multiple target DNAs each having a different sequence. We started with the hypothesis that by using sufficiently small probe and target lengths (number of bases) the resolution can be improved arbitrarily. However, detecting interactions among short DNA strands pose a challenge due to the short lifetime of these interactions. To address this challenge, we developed a high-speed atomic force microscopy based technique that can measure interaction forces among biomolecules on the microsecond timescale. Another challenge is the difficulty in discriminating target DNAs based on their sequences. Although interactions among complementary DNA strands are sequence dependent, the stochastic nature of force induced unbinding events makes it difficult to discriminate DNA sequences based on unbinding forces. To address this second challenge, we designed probes that can hybridize to multiple DNA targets, each creating a distinct force-distance relationship, thus providing a reliable fingerprint of molecular identity. Combing the high speed single-molecule mechanical measurements with specially designed probes allowed generating Angstrom-scale resolution, multicolor, chemically specific images. This new imaging platform should be applicable to problems like sequencing and protein structure determination and to the study of biomolecular complexes and subcellular structures by using short DNA stands as mechanical labels.

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for more information, or to join our mailing list please contact Amanda Olivo (ako2102@columbia.edu)