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Imaging Protein-Functionalized Quantum Dot Diffusion and Binding at Surfaces[1] JACK RIFE, JAMES LONG, LLOYD WHITMAN, Naval Research Laboratory — Understanding single biomolecule and nanoparticle interactions with surfaces at fluid-solid interfaces is a key to improving molecular transport and binding in many biotechnology applications. Biosensor sensitivity, for example, is typically limited by diffusion [2] and non-specific binding to analytical surfaces. We have assembled a Total Internal Reflectance Fluorescence (TIRF) microscopy system with single-photon-sensitive cameras to image diffusion and binding of fluorescently-labeled biomolecules on surfaces under both static and laminar flow conditions. We have acquired movies (57 frames/s) of streptavidin-functionalized CdSe quantum dots (QDs) diffusing, transiently attaching, and permanently immobilizing on repulsive, hydrophilic silica surfaces. From the single-particle trajectories we have extracted diffusion coefficients and transient attachment lifetimes. The binding of protein-functionalized QDs to our nominally repulsive surfaces can be attributed to surface defects, adsorbates, and protein conformational changes. In flow, the QD elevation above the no-slip surface can be approximated, giving a picture of elevated transport between transient attachments and QD departures to and from the surface. [2] Sheehan and Whitman, Nano Lett. 5, 803 (2005).

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