Single-Molecule Visualization of Corona Phase Molecular Recognition

Molecular recognition is central to the design of therapeutics, chemical catalysis and sensor platforms, with the most common mechanisms involving biological structures such as protein antibodies. However, identifying and isolating an antibody for a particular biological molecule is often costly and time-consuming, and their use is limited to physiological conditions in which protein antibodies remain stable. This work reports the development of a synthesis platform for the design of synthetic sensors, based on the principle of carbon nanotube Corona Phase Molecular Recognition (CoPhMoRe). The design of sensors with CoPhMoRe is based on the adsorptive properties of engineered heteropolymers to carbon nanotubes, which create a unique corona with molecular recognition properties for a target analyte. This phenomenon is shown to be generic, with new recognition complexes demonstrated for riboflavin, l-thyroxine, and estradiol, and confirmed with single-molecule imaging of the nanotube and the corona phase. The complexes can be used as new types of sensors based on modulation of carbon nanotube optical fluorescence, as demonstrated using a synthetic antibody for real time spatio-temporal detection of riboflavin in live murine macrophages. The analyte library for these synthetic sensors could be amplified to identify synthetic sensors for a variety of different molecules for which there currently exists no detection method.