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Label-free lectin microarrays using fluorescent carbon nanotube sensors: Towards rapid glycan characterization and synthetic lectin design

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Label-free lectin microarrays are a promising approach to rapidly characterize glycoprotein mixtures. However, to date, demonstrations of highly multiplexed label-free lectin microarrays have been limited. Our group uses near-infrared fluorescent single-walled carbon nanotubes to design glycan-responsive sensors capable of massive multiplexing and real-time detection for incorporation into a label-free lectin microarray. We employ two strategies for the design of our carbon nanotube sensors. The first design platform uses a His-tagged lectin that has been tethered to the nanotube via a Cu2+/NTA linker. We have demonstrated responsivity of these sensors to a variety of natural glycoproteins and to neoglycoproteins constructed from streptavidin and biotinylated sugars. Our second detection platform is based on Corona Phase Molecular Recognition (CoPhMoRe), a technology developed by our group at MIT whereby synthetic, non-biological recognition sites are created from the three-dimensional structure of a carbon nanotube and adsorbed heteropolymer. We have developed CoPhMoRe-based sensors for a variety of molecule types including carbohydrates resulting in the creation of synthetic lectins capable of being incorporated into the label-free microarray. These sensors, along with a binding kinetic model that we developed are capable of quantitatively characterizing glycoprotein mixtures at a much shorter time scale than existing characterization techniques. This technology has the potential to address longstanding problems in the fields of biopharmaceutical process analytics and medical diagnostics.

Biography

Michael S Strano is currently the Carbon P. Dubbs Professor of Chemical Engineering at MIT. He has received his BS from Polytechnic University in Brooklyn, NY and PhD from the University of Delaware both in Chemical Engineering. He was a Postdoctoral Research Fellow at Rice University in the Departments of Chemistry and Physics under the guidance of Nobel Laureate Richard E. Smalley. From 2003 to 2007, he was an Assistant Professor in the Department of Chemical and Biomolecular Engineering at the University of Illinois at Urbana-Champaign before moving to MIT. His research focuses on biomolecule/nanoparticle interactions and the surface chemistry of low dimensional systems, nano-electronics, nanoparticle separations and applications of vibrational spectroscopy to nanotechnology.

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