Our lab at MIT has been interested in how the 1D and 2D electronic structures of carbon nanotubes and graphene respectively can be utilized to advance new concepts in molecular detection. We introduce CoPhMoRe or corona phase molecular recognition as a method of discovering synthetic antibodies, or nanotube-templated recognition sites from a heteropolymer library. We show that certain synthetic heteropolymers, once constrained onto a single-walled carbon nanotube by chemical adsorption, also form a new corona phase that exhibits highly selective recognition for specific molecules. To prove the generality of this phenomenon, we report three examples of heteropolymers-nanotube recognition complexes for riboflavin, L-thyroxine and estradiol. The platform opens new opportunities to create synthetic recognition sites for molecular detection. We have also extended this molecular recognition technique to neurotransmitters, producing the first fluorescent sensor for dopamine. Another area of advancement in biosensor development is the use of near infrared fluorescent carbon nanotube sensors for in vivo detection. Here, we show that PEG-ligated d(AAAT), DNA wrapped SWNT are selective for nitric oxide, a vasodilator of blood vessels, and can be tail vein injected into mice and localized within the viable mouse liver. We use an SJL mouse model to study liver inflammation in vivo using the spatially and spectrally resolved nIR signature of the localized SWNT sensors. Lastly, we discuss graphene as an interfascial optical biosensor, showing that it possesses two pKa values in alkaline and basic ranges. We use this response to measure dopamine in real time, spatially resolved at the interface with living PC12 cells which efflux dopamine, indicating graphene’s promise as an interfascial sensor in biology.


Professor Michael S. Strano is currently the Carbon P. Dubbs Professor of Chemical Engineering at the Massachusetts Institute of Technology. He received his B.S from Polytechnic University in Brooklyn, NY and Ph.D. from the University of Delaware both in Chemical Engineering. He was a post doctoral 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, Michael 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. Michael is the recipient of numerous awards for his work from 2005 to the present.