Corona Phase Molecular Recognition at Carbon Nanotube Surfaces.

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Carbon nanotubes possess remarkable mechanical, electronic and optical properties that can be engineered for various applications upon chemical functionalization. As a counterpart to covalent chemistry, non-covalent functionalization in the form of an engineered, solution phase corona, or external adsorbed phase, has several advantages. By not disrupting the underlying graphene lattice, this functionalization can provide an interface to the environment while preserving the properties arising from 1D quantum confinement within the particle. This presentation will review our development of Corona Phase Molecule Recognition (CoPhMoRe), including its conceptualization, historical evolution, applications, and future prospects. As a molecular recognition methodology, CoPhMoRe creates a selective interface around nanoparticles from either biomolecular or non-biological origin, and therefore can access a much broader range of chemical and physical properties. It has significantly expanded the application space for single-walled carbon nanotube NIR fluorescent sensors over the past decade. Selected examples highlight the versatility towards creating fluorescent sensors for organic molecules, from steroid hormones and pharmaceuticals to larger analytes such as serum proteins and peptides, including insulin. The resulting nanosensors have proven their efficacy in complex biological media, with CoPhMoRe constructs demonstrating remarkable stability even in *in-vivo* environments, including both plants and animals. A new slate of specialized characterization tools provide essential understanding of the corona phase as a molecular layer on the nanoparticle surface that is otherwise difficult to probe. This presentation will also highlight the sizable task of solving what we call *the inverse problem*: using a target analyte's chemical structure to work backwards to a polymer or set of wrapping molecules that form a 3D corona on the carbon nanotube cylinder capable of molecular recognition of the target. We conclude by examining future prospects, weighing the opportunities and challenges awaiting the CoPhMoRe technique in the next decade.