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Electronic Interactions in Hybrid Organic-Nanoparticle Materials

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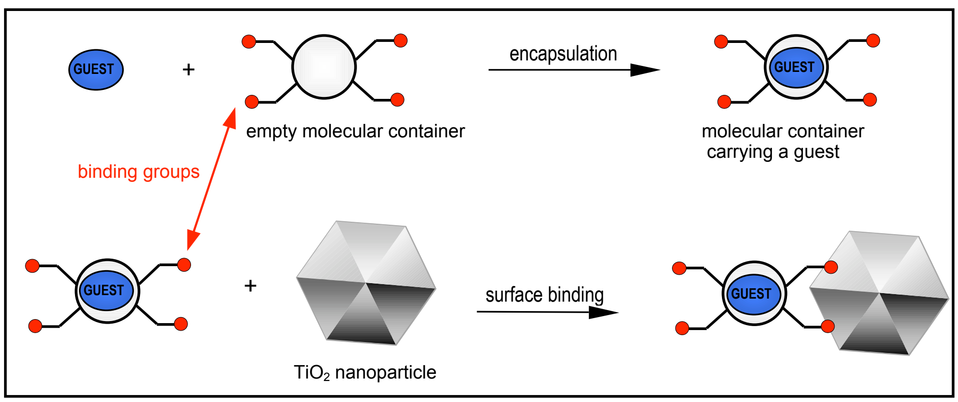
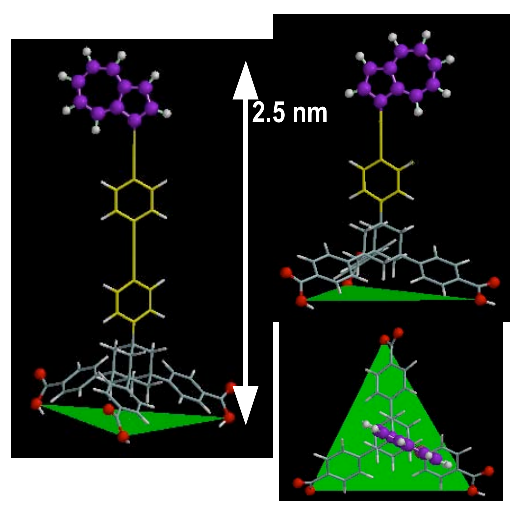
Hybrid systems consisting of molecular components and semiconductor nanoparticles capable of performing a desired complex function are being developed. The powerful combination of synthetic organic chemistry and nanomaterials allows a much great degree of control over the properties of these new materials than would be possible otherwise. The interdisciplinary team of researchers from Rutgers and Johns Hopkins universities is studying two types of such supramolecular assemblies:



A new class of nanoscale systems composed of guest molecules contained within supra-molecular capsules that are tethered to the surface of metal oxide nanoparticles has been developed. Both components, *i.e.* the 'molecular container' and the semiconductor particle, are of nanometer dimensions. The molecular container spontaneously and reversibly encapsulates a guest and binds it to the surface of a semiconductor nanoparticle. Potential applications of these assemblies as highly size-selective sensors of pollutants and molecular transporters are being investigated.



The communication between the molecular components and the semiconductor or metallic substrate lies at the heart of the development of functional nanoscale materials. In order to better understand and control these interactions at interfaces our team has developed 'molecular tripods' that allow precise positioning of electrically and optically active molecules on the semiconductor surface. The tripod is equipped with an organic bridge that acts as a 'molecular wire' and transmits signals (electrons) between the light-absorbing terminal group (shown in purple) and the nanoparticle. Using these systems it was possible to demonstrate that an electron can indeed be shuttled across 2.5 nm of an organic material in less than 1 picosecond, i.e. more than sufficiently fast for the design of future hybrid molecular/semiconductor electronic devices.

References:

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