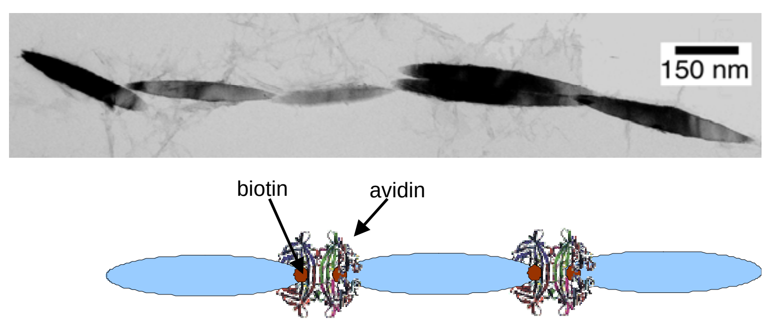
Office of Technology Transfer

Photoactivity of Protein-Nanoparticle Hybrid Systems

Nada Dimitrijevic, Zoran Saponjic, Tijana Rajh, Bryan Rabatic, Linda de la Garza

We have developed a semiconductor based bio-composite material to probe light-induced site-specific chemistries in biomolecules. In optimally designed hybrid systems, semiconductor particles, such as TiO_2, act as light-harvesting materials, and the photogenerated charges can induce changes in biomolecules. To this effect, we have established a union of bio-inert titanium dioxide (TiO_2) nanoparticles having selectable shape and size morphologies with organic biomolecules of known controlled chemical reactivity. This has resulted in methodologies to generate semiconductor-protein biomaterials. The uniqueness of this composite material is related to the atomic positioning of titanium metal atoms within the crystalline framework of the semiconductor nanoparticles. Taking advantage of the capability of protein (avidin) to strongly bind biotin molecules we have assembled a variety of nanocomposites, from wire-like nanorod structures to thin film electrodes. We have found that site-specific oxidation of avidin in TiO_2-dopamine-biotin-avidin hybrids alters the proteins' binding properties causing dissociation of the avidin-biotin complex.

The changes in avidin's binding properties is a step towards artificial manipulation of enzymatic catalytic reactions which are characterized by the changes in noncovalent binding



Linking of TiO_2 nanorods via avidin-biotin interaction

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