Facile, fast and high reproducible method for nanocrystals coupling to carbon nanotubes

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The future carbon-free energy scenario is moving towards the sustainable production of solar fuels based on artificial photosynthesis. This technology biomimics natural photosynthesis by capturing and storing energy from sunlight in chemical bonds, for instance, by splitting water into $H_2$and O. The success of this complex process is thanks to the multicomponent architecture of the natural enzymes. Inspired by the specifically engineered natural system, the SOLHYCAT project was designed with the aim of producing an artificial catalyst for water splitting, which components have been preciselyselected according to its function within the photochemical process. It is based on the junction between inorganic semiconductor nanoparticles (NPs) and a molecular catalyst (molCAT) through conductive carbon nanostructures (CNs). The NPs act as photoabsorbers, with controlled structure for efficientlightabsorption, electron-hole generation, band alignment and stable interface with the CNs. The latter has a key role as platform to anchor the molecular catalysts, which are responsible for the fast chemical reactions.

For decoration of CNTs we use an approach based on the incubation of NCs with CNTs being destabilized by change of the solvent polarization by using toluene, resulting in a controlled deposition of the previously synthesized semiconductor NCs. In this survey, several semiconductors such as Ag_2S[1], TiO_2 brookite and anatase[2], CdSe and CdSe@CdS[3] were synthesized and coupled to Single-Walled CNTs (SWCNTs) with positive results. This approach has proved in water destabilizing the NPs by dyalisis. Obtained results were characterized by transmission electron microscopy (TEM), scanning electron microscopy (SEM) or scanning transmission electron microscopy (STEM), prior and after incubation (Figure 1 and Figure 2 respectively), proving it to be fast, straightforward, highly reproducible and easily scalable.

References

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Figures

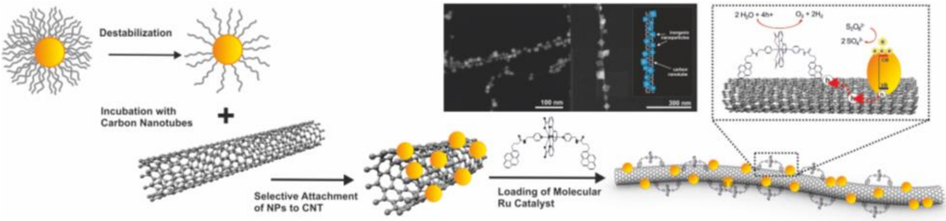

Figure 1: SOLHYCAT Scheme. Left: synthesis of decorated CNS with semiconductor nanoparticles. Right: molecular catalyst for direct and stable attachment to CNS.