Nanofabrication of mesoporous architectures for Dye Sensitized Solar Cells (DSSCs)

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Development of new technological solutions in the nanometer scale has produced new photovoltaic systems for the realization of low-cost solar cells in the near future. One of the most studied III generation device for the conversion of light into electrical energy is the dye-sensitized solar cell (DSSC) [1]. This solar cell is based on a TiO$_2$ nanoparticle photoelectrode sensitized with a light-harvesting metallo-organic dye. We realized novel Graetzel-inspired nanoarchitectures based on mesoporous structures of hollow polymeric nanocapsules containing Ruthenium complexes as shown in figure 1.

![Fig. 1 Design and components of the proposed nanostructured solar cell.](image)

Different Ru(II) complexes were used as donors together with a fullerene derivative (NC60) selected as electron acceptor: the redox couple was immobilized in a PAH/PSS polyelectrolyte shell surrounding CaCO$_3$ inorganic nanoparticles (NPs). Dissolution of the NPs core resulted in empty nanocapsules bearing the donors and the acceptor in different corona layers [2]. Combined AFM and Confocal Laser Scanning Microscopy (CLSM) provided information on the dimension and morphology of the nanocapsule systems as a function of shell thickness and surface charge, the study revealed a peculiar aggregation behavior when the acceptor was located in the outer layer.

![Fig. 2 CLSM imaging (left), steady-state (centre) and time-resolved (right) fluorescence emission for polymer nanocapsules with embedded Ru(II)/NC60 redox couple.](image)

Steady-state and time-resolved fluorescence investigation (Fig. 2) showed that efficient photoinduced electron transfer occurs between the donor and the acceptor in all cases but with different efficiencies that depend on the acceptor position in the layer sequence.