Synthesis and Characterization of Novel Carbon Materials-Porphyrin Hybrid Architectures as Active Light Harvesting Systems

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During the last decade, many research groups explored the possibility to use the sunlight as a renewable energy source by using artificial molecular networks able to mimic the natural photosynthetic process. These networks can be obtained from the combination of different moieties with various functionalities to get a composite material that has more complex functions. Meso-tetraphenylporphyrin connected with a ferrocene molecule in the beta-position of the macrocycle through a triple carbon-carbon bond has been bound to new carbon materials, graphene nanoplates and carbon spheres, using the Prato-Maggini reaction. The synthesis of graphene nanoplates (GNP) consists in a low cost, quickly realizable, scalable and stable fabrication method, relying upon the assistance of standard 800 W household microwave oven irradiation. Carbon Spheres (CSs) are obtained from a low-cost floating catalyst CVD process, generating spherical structures, like fullerene, with many internal graphitic rings. The ethynyl or/and phenylene ethynylene subunits were chosen as a linking bridge to give a high conjugation degree between the donor (ferrocene), the photoactive compound (porphyrin) and the acceptor (graphene nanoplates or carbon spheres). TEM and SEM microscopy help understanding the inner and outer morphology of CSs and the surface area or the layers number in GNP. Steady-state fluorescence studies together with Raman and XPS measurements helped investigating the chemical and physical properties of the porphyrin ring in the new adducts. In order to localize the preferential

binding sites, a mapping characterization has been carried out on the sample through the Raman imaging. Preliminary studies of transient absorption spectroscopy were performed to investigate the possible electron-transfer events in the hybrid materials, while electrochemical studies to underline the interactions between the different parts of the new adducts.