Rational Design of Bio-Organic Systems for Biomimetic Applications

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In the last five years, a lot of research effort has been devoted to the creation of hybrid materials which change the electronic properties of one constituent by changing the optoelectronic properties of the other one. The most appealing approach consists on the interaction between organic materials or metals with biological system such as proteins or DNA. Although experimental efforts have already resulted in the formation of a number of stable hybrid bio-organic materials, the main bottleneck of this research field is the formation of the interface between the biological part and the organic/metal one. In particular, the efficiency of the final devices is very low due to problems with the interfacing of such different materials, charge recombination at the interface and the high possibility of losing the function of the biological component which leads to inactivation of the device. Here, we present a multiscale computational design which allow the study of complex interfaces for stable and highly efficient hybrid materials for biomimetic application. In particular, we focus on the use of graphene as organic material/metal and light harvesting protein complexes (Photosystem I) as biological counterpart, linked together via a self-assembly monolayer (SAM) and a biological linker (cytochrome c553) to allow flexibility of the whole system, in order to create novel biomimetic materials for solar-to-fuel, bio-transistors or bioorganic electronic applications. [1-4]

**Figure 1.** Overview of the proposed rationally designed interface. The absorption of light by the reaction centre (RC) dimer triggers the charge transport to the graphene through the Cytochrome c553linker and then the self-assembled monolayer, which activates the bio-electronic device.

**References**