Hybrid lighting and photovoltaic devices

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Abstract: Hybrid organic-inorganic optoelectronics are heralded as the next generation of lighting and photovoltaic technologies. In this context, our efforts encompass three main actions, namely the development of suitable third generation of electroluminescent materials for ionic-based lighting devices, the application of nanocarbon-based hybrids in solar cells and lighting devices, and the development of bio-components for lighting, energy conversion, and diagnostic applications.

Herein, the implementation of the third generation of materials – *i.e.*, small molecules, copper(I) and Ag(I) complexes, and nanographenes – for light-emitting electrochemical cells (LECs) will be presented as new approaches to develop deep-red, blue, and white lighting sources. Next, carbon nanohorns will be shown as new integrative components for preparing new nanocarbon-hybrid dye-sensitized solar cells (DSSCs), resulting in several breakthroughs, namely i) the enhancement of charge transport and collection in the electrodes, ii) the development of iodine-free, solid-state electrolytes, and iii) the fabrication of platinum-free counter electrodes. Finally, a new strategy to stabilize any type of bio-components – *i.e.*, enzymes, fluorescent proteins, *etc*. - in a rubber-like material was developed. As an example, the latter was applied to fabricate the first bio-inspired hybrid light-emitting diodes featuring a bottom-up energy transfer protein-based cascade coatings. The synergy between the excellent features of fluorescent proteins and the easily processed rubber produces bio-HLEDs with less than 10% loss in luminous efficiency over months. Currently, other applications like bio-reactors and ready-to-go-kits are under development in our laboratory.