Description

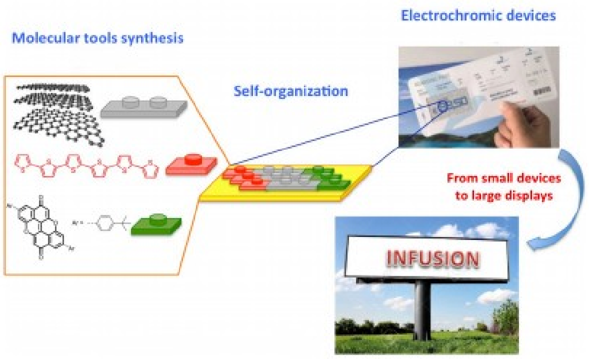
Investing in energy efficiency and saving is crucial to support energy accessibility and environmental protection, and it is the world's best interest to share and implement energy efficiency. This implies a stronger and effective transnational policy to promote and disseminate know-how about new technologies both at the market and R&D level. In this respect, development of projects centered on energy efficient technologies based on nanostructured organic materials is a strategic field. The progresses in mastering organic matter by self-assembly and self-organization to form ordered soft-materials revolutionized the field by opening new frontiers for both fundamental and applied research. However the route towards organic materials for application at the industrial scale is restricted by difficulties in the control and manipulation of the structural organization at the molecular level.

Motivated by the potential for significant energy savings, the INFUSION project aims to create a strongly interdisciplinary and inter-sectorial environment in which the principles of self-organization are poured from the Academia into the private sector and vice-versa to create new paradigms to engineer electrochromic devices.

The project aims at cross-fertilizing the electrochromic technology joining specific expertise to realize a bottom-up approach toward the design, preparation and characterization of self-organized organic materials (chromophores, CNSs, polymers...) at different interfaces (ITO, graphene) and exhibiting superior performances.

Specific objective

The design of new composite materials and the development of new methodologies for the realization of usable electrochromic devices, such as displays. These devices, must be characterized by low energy consumption and be cheap.



Methodology

Loading specific polymers with carbon anostructures may yield photo-active materials with unprecedented physico-chemical properties.

Self-organization is used to realize nanostructured layers from the composite materials, featuring enhanced conductivity, good emission quantum yield, controlled coloration, and durability.

The layers obtained are characterized by a large variety of methods. The aim is to understand how the measured electro-optical properties of these layers are correlated to the structure they present at different length scales.

The best composite materials prepared in the project will be used to prepare electrochromic inks with enhanced coloration efficiency, fast switching kinetics, durability, suitable lifetimes and processability.

The new materials, combined with new process methodologies, will be investigated for the preparation of large and cheap displays that, in principle, can be used to replace any luminous communication panel with almost zero-consuming energy.

Electrochromism

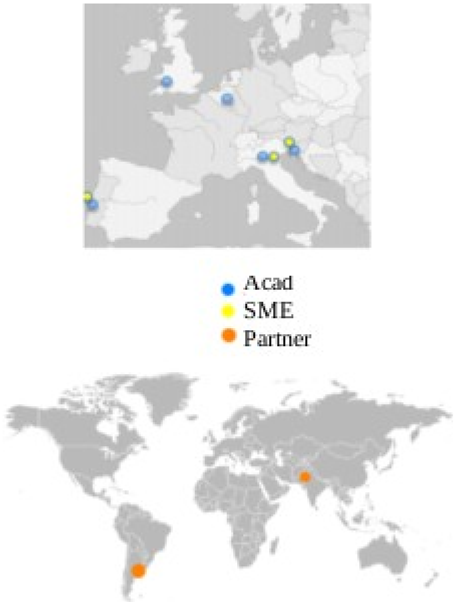
Electrochromism refers to the ability some materials have to change their optical properties –transparency, color-- after application of an electric voltage or current. The underlying mechanism can be physical: the transparency of a liquid crystal layer depends on the orientation of the crystals, which can be controlled by an electric field. It can be chemical as well: the color of a material can be modified reversibly by exchanging ions or electrons or both (electrochemical mechanism). Some inorganic oxides, organic molecules, conducting polymers, and metallopolymers are different classes of electrochromic compounds. An advantages of organic materials over inorganic materials is their lower cost and ease of processing.

Organic molecules have many advantages as electrochromes: high optical contrast between the colorless and the color states, fast response to an electric stimulus, good optical memory. The latter property means that the color stays for a long time after the application of the stimulus, which implies low power consumption. When the same molecule has several accessible redox states, it may present different colors. A redox reaction changes the molecular energy levels and, hence, the absorption spectrum.

Organic electrochromic molecules can be attached in huge quantity on nanopartices thanks to the large surface area the latter present. With such hybrid nanostructures, excellent efficiency and chromatic contrast can be achieved, together with the possibility to tune the color, which is truly important for display applications.

Partners

- Università degli Studi di Trieste (Italy)
- Cardiff University (Great-Britain)
- Consiglio Nazionale delle Ricerche (Italy)
- Universidade NOVA de Lisboa (Portugal)
- Ynvisible (Portugal)
- Mediteknology (Italy)
- A.P.E. Research (Italy)
- Université de Namur (Belgium)
- International Center for Chemical and Biological Sciences (Pakistan)
- Universidad Nacional de La Plata (Argentina)



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INFUSION

Engineering optoelectronic interfaces:
a global action intersecting
fundamental concepts and technology implementations of self-organized organic materials