Electrofluorochromism and its Application in Chemical Sensing: Detection of Sunscreen Molecules in Marine Environments

by Salma Hafed Khatiri | Departamento de Química Física and Instituto Universitario de Materiales de Alicante (IUMA)

Abstract ID: 39
Submitted: March 24, 2023
Event: CloudEARTHi Conference series - 2023
Topic: Blue growth & Green transition

Electrofluorochromism (EFC) have gained significant attention in the past decade. This phenomenon is defined as the process of modulation of light emission and coloration of a material in response to an external stimulus, such as an electric field or an electrochemical potential. The electrochemical version of this phenomenon is the modulation of a material's fluorescence under the influence of an electrochemical reaction that affects the redox state of the molecules involved.

Conjugated polymers (CP) are excellent electrofluorochromic materials. The physicochemical properties of CP are strongly influenced by their redox state. In neutral (undoped) state, conjugated polymers (polyfluorenes, polyphenylene-vinylene, etc.) are semiconductor materials with bandgaps ranging 1.5-3 eV. The presence of this bandgap is responsible of their optical properties, including luminescence emission. Upon electrochemical doping, the fluorescence of these polymer is quenched by the introduction of polarons in the conjugated chain. The reversible character of the electrochemical doping process in CP allows its applications in EFC. This effect has been used for the characterization of excited-state dynamics of conjugated polymers and allowed the determination of key parameters for the application of these materials in optoelectronic devices.

We have inspected the reversible EFC of a fluorene-based conjugated polymer, F8BT. During the electrochemical *p*-doping we found that a family of anionic species affect the EFC of F8BT. Concretely, some aromatic compounds with ionizable group. Based on this result, we investigated an application of this spectroelectrochemical technique for the development of chemical sensors. We have applied EFC to the detection and quantification of sunscreen molecules employed in cosmetic creams. The control of the concentration of these compounds in marine environment is significant since these compounds can be considered as emerging pollutants of seawater, specially in touristic coastal areas. The presence of these molecules is impacting some marine ecosystems, such as coral reefs. As a result, sunscreens are being banned in touristic areas. Many of these sunscreens contain aromatic molecules with anionic ionizable groups (sulfonic or carboxylic groups). The present work examines how one of these filters (ecamsule, terephthalylidene dicamphor sulfonic acid) affects the EFC of F8BT and this response allows their quantification. The

detection limit obtained is in the sub-µmolar range and it let to develop a sensor for environmental risks.