Low energy consumption electrochromic systems based on metallo-organic polymers

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Electrochromic materials are functional materials whose optical properties can be controlled by electrical stimulus, and therefore has considerable interest for different types of optical devices such as displays, light shutters, smart windows, variable-reflectance mirrors, smart labels and variable-emittance thermal radiators.

The majority of commercial available electrochromics materials are based on metal oxides such as tungsten trioxide or small organic molecules such as viologen and, although having long lifetimes they are usually rigid and their color palette is limited. The most promising alternative materials are probably conductive polymers. Being by nature flexible, they are characterized by high contrast ratios, fast switching times and low energy consumption. Additionally, their color states can be fine tuned by chemical functionalization: however, their major drawbacks for successful commercialization are still short term durability and large scale processability.

The poly[Msalen] are metallo-organic polymers based on salen-type complexes, which the electrochromic behavior have been recently extensively studied with promising results, specially, regarding to electrochemically stability.[1]

In this work, electrochromic systems based on poly[Ni(II)salen] were obtained by electropolymerisation of a rational set of Ni(II) salen complexes. The deposition was performed in flexible polyethylene terephthalate coated with indium-tin oxide (ITO/PET), by cyclic voltammetry. The experimental conditions, namely the supporting electrolyte and the number of potential cycles, were optimized for each complex, in order to fabricate films with good adherence to the substrate, good optical contrast and high cycle-life.

The polymeric films were characterized by cyclic voltammetry, in-situ UV-Vis spectroscopy and X-ray photoelectron spectroscopy, in two different states: as-prepared and passivated by continuous redox cycling.

Among the films studied, the poly[Ni(3-Mesalen)] showed the greatest electrochemical stability, exhibited colour change during around 9000 oxidation-reduction electrochemical cycles, with a good optical contrast.

The electrochromic devices were fabricated using an ionic conductive polymeric gel based on PMMA and a lithium salt, with lifecycles around 3000 oxidation-reduction electrochemical cycles.

References

[1] A. Branco, C. Pinheiro, J. Fonseca, J. Tedim, A. Carneiro, A.J. Parola, C. Freire, F. Pina, Electrochem. Solid St. 2010, 13, p. J114.