NEW NANOSTRUCTURED MULTICHROMIC MATERIALS FOR ELECTROOPTICAL DEVICES

M. Salsamendi, A. Viñuales, J. Rodriguez, J. A. Pomposo and C. Pozo-Gonzalo

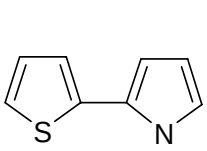
New Materials Department, CIDETEC, Parque Tecnológico de San Sebastián, Paseo Miramón 196, E-20009 Donostia-San Sebastián, Spain
Email: msalsamendi@cidetec.es

Electrochromism has attracted a lot of attention in the past decade due to potential applications of electrochromic materials in smart windows,[1] eye-glasses, rear-view mirrors, displays,[2] and variable optical attenuators.[3 4]

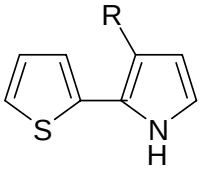
Electrochromism is defined as the property inherent to some materials which can electrochemically switch between different coloured states as a result of a redox reaction. Typical electrochromic behaviour lead to switching between a transparent or bleach state and a coloured state or between two different coloured states.

Many different types of organic and inorganic materials such as inorganic metal oxides, mixed-valence metal complexes, organic small molecules and conducting polymers exhibit electrochromic behaviour. Among the electrochromic materials, conducting polymers have received a great deal of attention due to outstanding electrochromic properties such as switching time, stability, colouration efficiency, or wide range of colours.

Previously, we have studied the electrochemical and electrochromic behaviour of poly(2-(2-thienyl)-1H-pyrrole) (**1**)[5] which showed an interesting orange to black electrochromic behaviour upon oxidation. This work lead us to synthesise new derivatives based on poly(2-(2-thienyl)-1H-pyrrole) bearing substituents with donor and acceptor properties.[6]



(**1**)



R = Ethyl (**2**)
Propyl (**3**)

In this communication, we report the electrochemical synthesis of copolymers **2** and **3** and their subsequent optical and electrochemical characterisation. Interestingly, the attachment of short alkyl chains lead to new electrochromic properties exhibiting multichromic behaviour with up to five different colours (dark orange, orange-yellowish, brown, blue and blue-greyish) (Figure 1). It is important to remark that although most electroactive polymers have the ability to exhibit two colours, only a few ones show multi-colour states.[7 8]

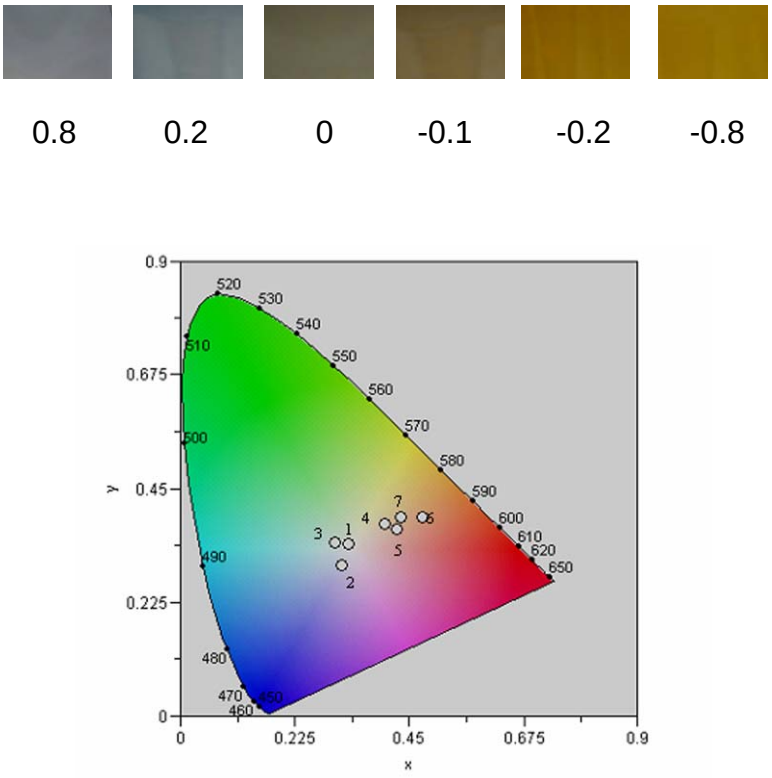


Figure 1: Multichromic behaviour of poly(**2**) films deposited on ITO plastic substrate (top) and CIE chromaticity diagram showing the corresponding (x,y) and (L*a*b*) colour coordinates (bottom). The numbers in the graph correspond to: 1 (as grown, blue - greyish), 2 (+1 V, blue - greyish), 3 (+0.8 V, light blue), 4 (0 V, brown), 5 (-0.1 V, brown), 6 (0.2 V, dark orange) and 7 (-0.8 V, light orange).

References:

[1] G. A. Niklasson, C.G. Granqvist, Journal of Materials Chemistry **12** (2007) 127.
[2] R.J. Mortimor, A.L. Dyer, J.R. Reynolds, Displays **1** (2006) 2.
[3] C. Pozo-Gonzalo, D. Mecerreyes, J.A. Pomposo, M. Salsamendi, R. Marcilla, H.J. Grande, R. Vergaz, D. Barrios, J.M. Sánchez-Pena, Solar Energy Material & solar Cells **92** (2008) 101.
[4] A.L. Dyer, C.R.G. Grenier, J.R. Reynolds, Advanced Functional Materials **9** (2007) 1480.
[5] C. Pozo-Gonzalo, J.A. Pomposo, J.A. Alduncin, M. Salsamendi, A.I. Mikhaleva, L.B Krivdin, B.A. Trofimov, Electrochimica Acta. **14** (2006) 4784.
[6] C. Pozo-Gonzalo, M. Salsamendi, J.A. Pomposo, H.J. Grande, E.Y. Schmidt , Y.Y. Rusakov and B.A. Trofimov, Journal of Materials Chemistry, 2008 (under revision).
[7] S. Varis, M. Ak, IM. Akhmedov, C. Tanyeli, L. Toppare, Journal of Electroanalytical Chemistry **1** (2007) 8.
[8] CL. Gaupp, JR. Reynolds, Macromolecules **17** (2003) 6305.