PEDOT/PBEDOT-NMCz Dual Polymer Electrochromic Devices with Ionic Liquid Based Gel Electrolyte

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The use of poly(3,4-ethylenedioxythiophene) (PEDOT) as an electrochromic material is widespread [1]. Its incorporation into electrochromic devices (ECDs) in both the five-layer (single polymer ECD) and seven-layer (dual-polymer ECD) [2,3] configurations has also been accomplished. Herein we report the construction and characterization of dual-type ECDs using PEDOT and poly[3,6-bis(2-(3,4-ethylenedioxy)thienyl)-N-methylcarbazole] (PBEDOT-NMCz) as the two polymers for the device. Electrochemical switching of a dual-type electrochromic device involves complementary color change of the constituting polymers. For PEDOT, the oxidized form is the bleached state, which allows the reduced form of PBEDOT-NMCz to be seen through the device. Both neutral PEDOT and oxidized PBEDOT-NMCz show dark blue color, thus increasing the performance of the electrochromic device. A variety of gel electrolyte solutions were prepared and evaluated within these devices as well. The use of ionic liquids within these gels imparted interesting properties, including long lifetimes and thermal stability of devices. Switching speeds for the various devices, as well as optical contrasts, were also obtained. The potential use of these materials in chameleonic devices is but one of the many applications for electrochromic materials. The development of optical camouflage requires a variety of colors produced over short periods of time, and the wealth of electrochromic materials makes it easy to envision such a system. Further, applications of single-polymer devices include smart windows, which can not only provide shade for an office or home, but can also reduce energy expenditures from air conditioning by allowing less heat to enter the building during the warmer months. Such systems can be employed on much smaller scales as well, in areas such as eyeglass manufacturing. Achieving a simple way to mimic the full color gamut of human vision remains a challenge for the electrochromic field, but one which is exciting and fruitful.

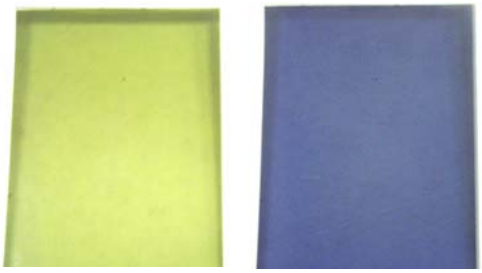

Figure 1 Bleached and colored states of a dual polymer electrochromic device, composed of PEDOT and PBEDOT-NMCz

[1] S. Kirchmeyer, K. Reuter, *Journal of Materials Chemistry*,15 **2005** 2077 "Scientific importance, properties and growing applications of poly(3,4-ethylenedioxythiophene)"
[2] S. A. Sapp, G. A. Sotzing, J. R. Reynolds, *Chemistry of Materials*, 10 **1998** 2101 " High contrast ratio and fast-switching dual polymer electrochromic devices".
[3] A. A. Argun, P. H. Aubert, B. C. Thompson, I. Schwendeman, C. L. Gaupp, J. Hwang, N. J. Pinto, D. B. Tanner, A. G. Macdiarmid, J. R. Reynolds, *Chemistry of Materials*, 16 **2004** 4401 "Multicolored electrochromism polymers: Structures and devices"