Stable Conducting Polymer Electrochromic Devices Incorporating Ionic Liquids

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In the development of long-lived electrochemical devices based on conducting polymers, the electrolyte plays an extremely important role. Good electrolytes should have high ionic conductivity, large electrochemical windows, excellent thermal and chemical stability, and negligible evaporation rates. Room temperature ionic liquids are good electrolyte candidates that meet these requirements. On the other hand, conducting polymers possess desirable physical properties for electrochemical devices such as light weight, low cost, good redox capability, good processability, mechanical flexibility, and high charge capacity. In the present work, we combined the unique properties of ionic liquid electrolyte with those of conducting polymers to fabricate high performance and long lifetime electrochromic devices. More specifically, we have explored the application of ionic liquids in: a) electrochemical synthesis of thin transparent films of conducting polymers (e.g., polypyrroles, polythiophenes, and polyanilines); b) in the electrochemical characterization of conducting polymer thin films; and c) in the fabrication of stable conducting polymer electrochemical devices including electrochromic windows and numeric displays. An excellent lifetime of 1,000,000 cycles for the electrochromic devices has been achieved without change in the performance of the device.

The Ionic Liquid Electrochromic Display (ILECD) changes its color and transparency when an appropriate voltage is applied. The essence of the devices is shown in Figure 1. It consists of two conducting polymer (also referred to as π-conjugated polymers) thin films deposited onto the surface of ITO glass electrodes, with an ionic liquid electrolyte "sandwiched" in between them. The use of room temperature ionic liquids as the electrolyte is the key enabling-technology leading to commercial viability. The applied voltage induces redox reactions in the polymers, which changes their color and transparency.

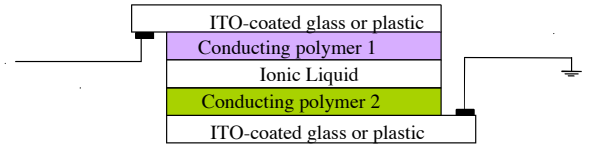

Figure 1 Ionic liquid electrochromic device**.**