

## Electrochemistry and Electrochromism in Star Conductive Polymers

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Star conductive polymers have the general structure of a central core with multiple branching points and with linear conjugated polymeric arms radiating outward [1]. We report here the synthesis, spectroelectrochemistry and electrochromic device properties of several of these novel materials.

Star conductive polymers were synthesized in which the centrosymmetric cores include hyperbranched poly(1,3,5 phenylene) (PP) and poly(triphenylamine) (PTPA) and the radiating arms are *regioregular* poly(3-hexyl) thiophene, poly(3,4-ethylenedioxythiophene-didodecyloxybenzene) and poly(dibutyl-3,4-propylenedioxythiophene). These polymers are all castable by spin coating from a carrier solvent such as THF, and several can be doped in solution, so that thin films of both doped and undoped forms can be prepared. Their electrochemistry is generally similar to that of the linear arms when PP is the core, but PTPA provides reversible redox activity that can anodically protect the arms from overoxidation.

The polymers all have spectral features that produce a strong band in the visible region for the reduced state and a broad band extending into the NIR for the oxidized state. The positions of these bands define the color of the polymers, which range from red to violet to deep blue in the reduced state, and blue to very pale blue in the oxidized state. The conductive polymer arms show very high coloration efficiencies  $>1400 \text{ cm}^2/\text{C}$  at their  $\lambda_{\text{max}}$  in several cases. As a result, variable transmission devices can be assembled quite simply with "low" coloration efficiency counter electrodes like  $\text{WO}_3$ . The coloration efficiencies at several wavelengths for a device having poly(dibutyl-3,4-propylenedioxythiophene) (arms)/PP core as the working electrode and  $\text{WO}_3$  as the counter electrode is shown in Figure 1. It is further seen that the coloration efficiency is not constant, with most of the color change occurring during the first ~25% of the inserted charge capacity. The properties of these devices will be reported, and the applications of high coloration efficiency electrochromic materials to displays and windows will be summarized.

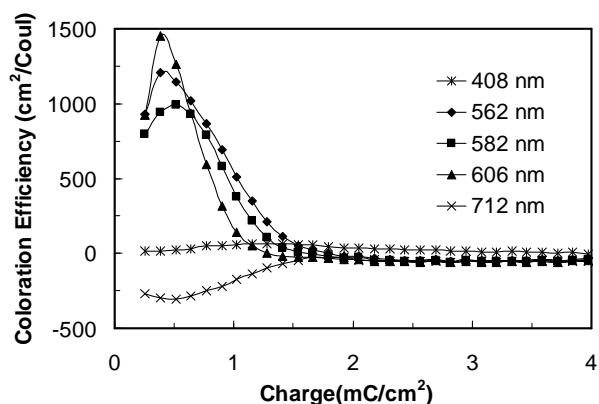


Figure 1. Coloration efficiency versus inserted charge for the device glass|ITO|star poly(dibutyl-3,4-propylenedioxythiophene)/PP|PMMA gel electrolyte| $\text{WO}_3$ |ITO|glass

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