ELECTROCHEMICAL AND OPTICAL PROPERTIES OF N-SUBSTITUTED POLY(3,4-PROPYLENEDIOXYPYROLE)S

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A series of N-substituted poly(3,4-propylenedioxy pyrole)s (PProDOP)s was synthesized and their electrochemical and electrochromic properties are reported. The N-substitution modifies the band gap of the polymer thus yielding new electrochromic properties compared to non-substituted PProDOP. Multi-color electrochromism can be achieved with these polymers giving a new set of colors including purple, green, brown and blue. As a result of the substitution, the $\pi-\pi^*$ transition in the polymer is shifted to the UV range thus leading to an optically transparent neutral polymer which becomes colored upon oxidation. For instance, films of N-Glycol PProDOP switch between an almost 100% transmissive colorless neutral state to blue upon doping. Spectroelectrochemistry showed that the absorbance of the $\pi-\pi^*$ transition in the neutral state is blue shifted compared to regular PProDOP. In the case of poly(N-glycol ProDOP) (N-Gly PProDOP), this transition displays a maximum at 306 nm thus giving an almost colorless highly transparent neutral polymer with a relative luminance of almost 100%. Another interesting feature of the new N-substituted PProDOPs is their electrochemistry where almost 'ideal' behaviors are obtained with N-Propyl PProDOP (N-Pr PProDOP), N-Octyl PProDOP (N-Oct PProDOP) and N-Glycol PProDOP (N-Gly PProDOP). For these polymers which show an $E_{1/2}$ less than mV/s less than -0.1 V vs Fc/FST, the ratio between anodic and cathodic peak currents at a scan rate of 20 mV/s is almost 1-0 and the difference between anodic and cathodic peak potentials ($AE_{p}$) is less than 8mV. In addition, these polymers have shown interesting electrochromic properties in the visible.