Synthesis of Copolymers Based on Thiophene, Methoxythiophene, Propylenedioxythiophene and Quinoxaline Units and their Optical and Electrochemical Properties

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Three D-A-type conjugated copolymers namely PTQET-1, PTQET-2 and PTQET-3 were designed employing quinoxaline units as the acceptor, thiophene, methoxythiophene and 3,4-propylenedioxythiophene (ProDOT) units as the donor. The three polymers had different feed ratio of the units and exhibited different electrochromic properties. They showed significant color changes during oxidation process with low optical band gaps as 1.51 eV for PTQET-1, 1.42 eV for PTQET-2, and 1.29 eV for PTQET-3. In particular, PTQET-2 and PTQET-3 displayed rare neutral black color. In the kinetic experiments, the three polymers presented high coloring efficiency and optical contrast in the near-infrared region, and especially PTQET-2 showed short switching time less than 1 s both in the near-infrared region and in the visible region. Besides, the polymers possessed favorable electrochromic stability and thermal stability. The new polymers reported in this paper provided a novel structural design for neutral black electrochromic materials, and they were worthy of attention and research.

Keywords: D-A type copolymers, thiophene derivatives, quinoxaline, electrochromism, neutral black

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