ABSTRACT

Synthesis and characterization of viologens as functional materials for applications in electrochromic devices

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This work is based on three articles and focuses on viologens, pyridinium salts, and pyridine derivatives as potential materials for electrochromic applications. The research was aimed at obtaining a series of viologens containing various bridging units between *N*-substituted pyridine rings and investigating their electrochromic properties. Both star-shaped derivatives containing three *N*-substituted pyridine rings and linear compounds incorporating two *N*-substituted pyridine rings were designed, along with mono-substituted pyridinium salts and their pyridine derivatives. It was expected that the introduction of different redox-active units such as triphenylamine, benzothiadiazole (BTZ), or benzoselenadiazole (BSeZ) into the viologen structure would induce reversible color changes under both cathodic and anodic conditions, providing electrochromic behavior.

The first group of star-shaped viologens consisted of derivatives containing a 1,3,5-trisubstituted benzene and triphenylamine core. The second group included linear viologens with *N*-substituted pyridine rings linked by BTZ or BSeZ bridging units. The modification of pyridine rings in linear viologens was also directed toward their functionalization with double-bond-containing groups (styrene units). The obtained BTZ- and BSeZ-based polyviologens represent the first reported example of using styrene-derived units for the photopolymerization of electrochromic materials. New non-symmetric mono-substituted pyridinium salts, pyridine derivatives, and their polymers containing BTZ or BSeZ cores connected to the triphenylamine and hexyl chains were also synthesized and characterized, representing donor–acceptor-type compounds.

The characterization involved spectroscopic, electrochemical, spectroelectrochemical, and, for selected compounds also luminescence analysis. The studies expand the current knowledge of viologens, pyridinium salts, and pyridine derivatives in the context of electrochromism. The results obtained fit within the recent research trends in functional materials for electronics and indicate the potential application of the synthesized and studied compounds in color-changing devices.