

Electrochemistry of Polypyrrole Derivatives with Sulfur-Containing Groups

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A great variety of conducting polymers have been synthesized and examined in view of various applications such as batteries and electrochemical capacitors, sensors, electrochromic displays electrocatalysts, etc. It is a recent trend in the development of conducting polymer materials of practical use that conducting polymers are molecularly coupled with other organic and inorganic compounds to attain noble functions or to mutually compensate drawbacks. In this context we have introduced various electroactive species covalently onto conducting polymer chains in an attempt to enhance electrochemical coupling between conducting polymers and introduced groups for the development of new functional materials based on conducting polymers.

The objective of this study is to develop a noble, conducting polymer-based electrode material with high energy density for polymer lithium batteries by covalently introducing electroactive organosulfur groups onto conducting polymer chains. Organosulfur compounds with multiple thiol groups have been expected as one of good candidates for high capacity cathode materials for lithium batteries. However, sluggish electron-transfer reactions severely hinder the practical use of organosulfur compounds in batteries operative at room temperature. We have reported that conducting polymers are capable of accelerating the slow kinetics of organosulfur redox reactions by virtue of electrocatalytic activity of conducting polymers¹⁻⁷. It is expected that enhanced interaction between conducting polymers and organosulfur species further accelerates the electron-transfer reactions of organosulfur compounds, leading to high performance cathode materials with high energy density.

In this study, we prepared several pyrrole monomer derivatives which were modified with electroactive sulfur-containing substituents such as thiols. These pyrrole monomers were electrochemically polymerized to yield thin films on electrode surfaces. The obtained polypyrrole films were electroactive and electroactivity of the films were dependent on the monomer used for the polymerization. It seems, however, polypyrroles prepared from the monomers with alkylthiol groups showed poor electroactivity compared to unmodified polypyrrole. On the contrary, some of the polypyrrole derivatives containing sulfur-containing groups other than thiols showed enhanced electroactivity, which suggested that the sulfur-containing groups introduced onto polypyrrole chains being electroactive and redox

reactions of these sulfur-containing substituents being accelerated by electrocatalytic activity of polypyrrole chains.

These noble polypyrrole derivatives modified with electroactive sulfur-containing groups are expected highly promising as a high energy cathode material for polymer lithium batteries.

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