Radiation-induced polymerization of poly(3-alkylthiophene)

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Conductive polymers are finding some applications in antistatic coatings, rechargeable batteries, sensors, organic light emitting diodes and organic thin film transistors. Most of conductive polymers have been synthesized by chemical polymerization or electropolymerization. However, these methods cause problems such as metal contaminations due to metal compounds used as catalysts and electrodeposition of the polymers. In this study, we tried radiation-induced polymerization of poly(3-alkylthiophene) (Scheme 1). This method does not require special equipments, can be performed under various condition, and is free from the metal contaminations. Neat 3-octylthiophene(3OT) and solutions of 3OT in hexane and chloroform were degassed in quartz cells or glass tubes. They were irradiated with \(\gamma\)-ray at the room temperature. Optical absorption spectra were measured with Shimadzu UV-3600 spectrophotometer. Molecular weight distributions were evaluated by gel permeation chromatography (GPC) with a Shimadzu GPC-803 column.

Figure 1 shows optical absorption spectra of neat-3OT, solutions of 3OT in chloroform and in hexane with \(\gamma\)-ray to a dose of 50 kGy. The solution of 3OT in chloroform showed an absorption peak at 480 nm which can be assigned as a peak due to poly(3-octylthiophene). Figure 2 shows Optical absorption spectra of 0.1 mol dm\(^{-3}\), 0.5 mol dm\(^{-3}\) and 1 mol dm\(^{-3}\) solutions of 3OT in chloroform irradiated with \(\gamma\)-ray. The solutions were diluted until the monomer concentrations were 10\(^{-4}\) mol dm\(^{-3}\). As the concentration increases, the onset of the spectra are shifted to longer wavelengths. It is due to increase in the molecular weight of the generated polymers. The increase will be ascribed to increase in the rate of hopping transfer of charge of the monomer cations with increasing the monomer concentration.

![Figure 1. Optical absorption spectra of neat-3OT, solutions of 3OT in chloroform and in hexane irradiated with \(\gamma\)-ray to a dose of 50 kGy.](image1)

![Figure 2. Optical absorption spectra of 0.1 dm\(^{-3}\), 0.5 mol dm\(^{-3}\) and 1 mol dm\(^{-3}\) solutions of 3OT in chloroform irradiated with \(\gamma\)-ray. The solutions were diluted until the monomer concentrations were 10\(^{-4}\) mol dm\(^{-3}\).](image2)