INVESTIGATION OF POLY(PYRROLE-CO-ANTHRANILIC ACID) COPOLYMERS SYNTHESIZED USING DIFFERENT AMMONIUM PERSULFATE-TO-MONOMER RATIOS

Amelia Hendik[1], Justina Gaidukevič[1,2]

[1]Vilnius University, Faculty of Chemistry and Geosciences, Institute of Chemistry, Vilnius, Lithuania
[2]Center for Physical Sciences and Technology, Vilnius, Lithuania
amelia.hendik@chgf.stud.vu.lt

Conducting polymers, such as poly(pyrrole) and poly(anthranilic acid), are known to combine electrical conductivity with chemical functionality, making them promising for electrochemical and sensing applications [1], [2]. Structural and morphological properties of these polymers can be tailored through copolymerization and are strongly influenced by synthesis conditions as well as oxidant concentration [3]. Given the wide range of oxidant concentrations reported in the literature, systematic optimization is required to obtain copolymers with controlled structure, balanced electrical conductivity, and reproducible electrochemical performance.

The aim of this study was to systematically evaluate the effect of the ammonium persulfate (APS) ratio on the structural and morphological characteristics of poly(pyrrole-co-anthranilic acid) (PPy-AA) copolymers, while maintaining a fixed monomer ratio of 3:1, in order to optimize synthesis conditions for improved material functionality. The PPy-AA copolymers were synthesized via chemical oxidative polymerization at varying APS-to-monomer ratios of 1:1, 1;1.25, 1:2, 1:3, and 1:66.

The structural, morphological, and surface characteristics of the synthesized PPy-AA copolymers were investigated using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), Raman spectroscopy, and Fourier-transform infrared spectroscopy (FTIR). A granular, spherical particle morphology was observed in SEM images. Smaller particle sizes as well as increased agglomeration were noted at higher APS ratios. Changes in oxidation state and conjugation were confirmed by Raman and FTIR spectra. Modifications in the delocalized π-electron system were also indicated. Systematic variations in elemental composition were revealed by EDX analysis. At excessive APS levels, increased oxidation of pyrrole rings was observed, and partial degradation of the polymer chains was recorded. It was concluded that the APS ratio strongly influenced the structural and morphological properties of PPy-AA copolymers.

Keywords: Poly(pyrrole-co-anthranilic acid); conducting copolymers; ammonium persulfate; oxidative polymerization; structural and morphological characterization.

[1] S. Jadoun, D. S. Rathore, U. Riaz, and N. P. S. Chauhan, “Tailoring of conducting polymers via copolymerization – A review,” European Polymer Journal, vol. 155, 110561, 2021.
[2] R. McCormick, “Anthranilic acid: a versatile monomer for the design of functional conducting polymer composites,” Journal of Composites Science, vol. 8, no. 6, p. 208, 2024.
[3] B. H. Patil, R. N. Bulakhe, and C. D. Lokhande, “Supercapacitive performance of chemically synthesized polypyrrole thin films: effect of monomer to oxidant ratio,” Journal of Materials Science Materials in Electronics, vol. 25, no. 5, pp. 2188–2198, 2014.