Ion-selective composite carbon electrode coated with TiO$_2$ nanoparticles for the application of electrosorption process

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ABSTRACT

Composite carbon electrodes with ion selectivity were fabricated using mixtures of sulfonated polystyrene and Titanium dioxide (TiO$_2$) nanoparticles that were coated onto carbon electrodes. After composite carbon electrodes with various TiO$_2$ contents were coated in the coating solution in the range of 0–20 wt%, the scanning electron microscopy, cyclic voltammetry (CV), and electrical impedance spectroscopy (EIS) were performed. In addition, the desalination performance was evaluated through the use of a capacitive deionization (CDI) unit cell. The CV and EIS analyses of the composite carbon electrodes showed that the electrical resistances of the coating layers decreased significantly as the TiO$_2$ content increased. In contrast, the ion selectivity decreased as the TiO$_2$ content increased because of the pores formed among the particles. In this study, the optimal content of TiO$_2$ in the composite carbon electrodes in terms of electrical resistance and ion selectivity was found to be approximately 10 wt%. In addition, the desalination experiments confirmed that the desalination efficiency of the composite carbon electrodes was improved by approximately 30% over that of unmodified carbon electrodes. The composite carbon electrodes fabricated in this study can be used effectively in the CDI process.

Keywords: Composite carbon electrode; TiO$_2$ nanoparticle; Capacitive deionization; Ion selectivity; Electrical resistance

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