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Facile synthesis of polypyrrole/ionic liquid nanoparticles and use as an electrocatalyst for oxygen evolution reaction

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Abstract

In this study, we report a simple approach based on the complexation of water soluble polymer with metal cations, for fabricating well defined polypyrrole (PPy)/ionic liquid (IL) nanoparticles (24-44 nm in diameter) by chemical oxidation polymerization. This procedure doesn't require harsh environment such as temperature and pressure and the simple process offers a great possibility for mass production of polymer nanoparticles. The obtained PPy/IL nanoparticles were tested as an electrocatalyst for oxygen evolution reaction. We have not added any transition metal or metal oxide. But, the as-prepared catalyst has ionic liquid which containing 1-allyl-3-methylpyridinium cation and tetrachloronickelate anion complex. The as-prepared catalyst PPy/IL nanoparticles showed the Tafel slope of 53 mV dec⁻¹. High catalytic activity of PPy/IL for OER is evident from low onset potential of 516 mV ($\eta_1=328$ mV) and high current density observed in the polarization curve. Moreover, the as-prepared catalyst achieved current density of 10 mA cm⁻² at low potential of only 583 mV which corresponds to an overpotential of only 392 mV.

Keywords: ionic liquids, polypyrrole, nanoparticles, conducting polymer, oxygen evolution.

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