Preparation of Thermostable and Electroconductive PANI/TDI-CeO₂ Composite by Graft Polymerization and its Electrochemical Properties

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doi: 10.20964/2018.02.55

Received: 9 July 2017 / Accepted: 24 August 2017 / Published: 28 December 2017

Electroconductive polymer/inorganic particle composites have been found to have unique physiochemical properties and important application value in many fields. However, previously reported composites are of low thermostability and poor electroconductivity. Here in the article, a novel hybrid composite of PANI/CeO₂-TDI was proposed to overcome those shortcomings. Firstly, cerium dioxide (CeO₂) was successfully modified by toluene-2,4-diisocyanate (TDI) via the addition reaction between TDI molecules and -OH groups at the CeO₂ particles' surface. The reactive -NCO groups at the surface of those modified particles further reacted with polyaniline (PANI) by graft polymerization to give the target composite, whose structure is characterized by FTIR and XRD, respectively. The thermogravimetric analysis (TGA) was used to characterize the thermal stability of obtained composites, and their electrochemical performances were characterized by rotating disc electrode (RDE) method in an electrolyte solution of 150 g/L H₂SO₄ and 65 g/L Zn²⁺ at 35 °C. The results showed that the target composite starts decomposing at about 260 °C which is the highest compared with control samples (pure PANI (~215 °C) and PANI/CeO₂ (~226 °C)), has the lowest static oxygen evolution potential (1.78 V vs MSE) compared with pure PANI (1.92 V, vs MSE) and PANI/CeO₂ (1.84 V, vs MSE) as well as the dynamic oxygen evolution potential as shown in the measured anodic polarization curves, possesses the largest electrode surface current density ($2.9 \times 10^{-4} \text{ A} \cdot \text{cm}^{-2}$) compared with pure PANI ($7.3 \times 10^{-5} \text{ A} \cdot \text{cm}^{-2}$) and PANI/CeO₂ ($1.2 \times 10^{-4} \text{ A} \cdot \text{cm}^{-2}$), and also owns the largest reaction rate constant ($1.39 \times 10^{12} \text{ m} \cdot \text{s}^{-1}$).

Keywords: Cerium dioxide, toluene-2,4-diisocyanate, graft polymerization, polyaniline, rotating disk electrode(RDE)

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