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Synthesis and characterization of polypyrrole/carbon composite as a catalyst support for fuel cell applications

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ABSTRACT

Polypyrrole (PPy)/Carbon composites were synthesized by in situ chemical oxidative polymerization of pyrrole monomer on carbon black. Effects of polymerization temperature (either 0 °C or 25 °C) and different dopants including *p*-toluenesulfonic acid (*p*-TSA) and sodium dodecyl sulfate (SDS) on the properties of the composites were investigated. The synthesized composites were characterized by XRD, FTIR and TGA. Electrical conductivities of the composites were determined by using four-point probe technique. Electrochemical oxidation characteristics of the synthesized PPy/Carbon composites were investigated by cyclic voltammetry via potential holding experiments. The PPy/Carbon composites synthesized at 0 °C and with *p*-TSA as dopant showed the best oxidation resistance than carbon and other composites.
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1. Introduction

Considering the numerous advantages of the fuel cells, as well as demand from various industries, a question is posed why they have not been commercialized so far [1]? The bottleneck related with the commercialization of the fuel cells is the high cost and also the degradation of the components during the long-term operations in fuel cell [2]. The life-time tests take too much time so mostly accelerated degradation tests are applied to the components in order to determine the durability [3].

Development of long-term durable fuel cell catalysts plays a critical role in commercialization of proton exchange membrane (PEM) fuel cells in the aspects of the cost and the fuel cell performance [2,4]. Platinum is the most active metal for the anode and the cathode electrochemical reactions of PEM fuel cells and if Pt is used effectively, the performance of PEM fuel cell can be improved further [5]. The parameters such as alloy composition, uniformity, morphology, particle size, electronic state, etc. must be controlled to achieve the highly efficient catalysts [6]. High surface area carbon supports are commonly used to increase the Pt surface area including active carbon, carbon black, carbon nanotubes and carbon aerogel [7,8]. Carbon black such as Vulcan XC-72 has been the most widely used catalyst support due to its superior properties [6].

The carbon surface oxide groups are formed during the long-term operations of fuel cells and further oxidation of these groups resulted in carbon dioxide formation named as carbon corrosion which causes performance losses in the fuel

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