The Design and Synthesis of a Novel N-Co-Mo-MWCNT Fuel Cell Catalyst for ORR in Acidic Conditions

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Currently, carbon dioxide (CO2) released from the burning of petroleum-based fuels contributes significantly to environmental and economic problems associated with fossil fuel dependence. Hydrogen fuel cells are the most likely renewable energy candidate to replace combustion engines in automobiles due to their low operating temperatures and quick start-up times. However, the high cost of the platinum catalyst prevents fuel cells from becoming economically competitive. Thus, there is a need to produce an inexpensive alternative catalyst with electrocatalytic performance comparable to platinum. The goal of this study was to produce a novel multiwalled carbon nanotube fuel cell catalyst doped with nitrogen, cobalt and molybdenum impurities for the oxygen reduction reaction (ORR) in acidic media. Multiwalled carbon nanotubes synthesized with cobalt and molybdenum impurities were submitted to a post-doping procedure with ammonia to incorporate nitrogen atoms into the outer walls of the nanotubes. Cyclic voltammograms of the nitrogen-doped N-Co-Mo-MWCNT catalyst, the Co-Mo-MWCNT catalyst without doping, and a conventional Pt/C catalyst were taken using a rotating disc electrode. ORR curves were also taken for the N-Co-Mo-MWCNT catalyst to determine its catalytic activity for that reaction. The N-Co-Mo-MWCNT catalyst displayed a significant increase in catalytic activity compared to the non-doped catalyst and was more effective for ORR than platinum. Though overall, it was not as catalytically active as the conventional platinum catalyst, the nitrogen-doped catalyst improved the kinetics of the ORR, which suggests a strong potential as an effective novel fuel cell catalyst and is a significant contribution toward a sustainable future of energy.