21st International Conference on

Advanced Energy Materials and Research

July 11-12, 2019 | Zurich, Switzerland

Nitrogen free oxygen doped carbon nanotubes for oxygen reduction reaction

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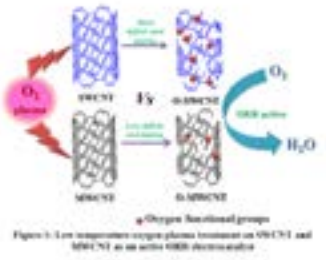
Oxygen reduction reaction (ORR) is pivotal in renewable energy technologies such as in fuel cells and metal-air batteries. ORR is most fundamental and an important cathodic reaction of the electrochemical fuel cell. However, owing to its sluggish nature at the cathode side of proton exchange membrane fuel cell (PEMFC), there is an urgent demand for a cost-effective efficient catalyst with fast ORR kinetics. Though in practice, Pt-based electrodes and N-doped carbon material shows promising ORR activity, the durability, cost and their preparation methods restricts their wide commercialization. To address this issue, we developed metal and nitrogen-free carbon nanotubes (CNTs) through simple and mild plasma treatment. Oxygen plasma treated CNTs were used as a model for comparative study of oxygen reduction on single (SWCNT) and multi-walled nanotubes (MWCNT). Cold oxygen plasma surface modification leads to chemical doping of oxygen functionalities into the sp^2 carbon structure of the CNTs, charge redistribution around the doped heteroatom oxygen that promotes ORR activity. The defect sites generated owing to oxygen dopant in CNTs was confirmed by Raman spectra and X-ray photoelectron spectroscopy (XPS) surface composition. Hence, the results indicate that plasma treated SWCNT are more effective ORR catalyst compared to MWCNT due to the inherent structure of SWCNT that can access more defects and surface functional groups than MWCNT. Interestingly, for the first time we explored the comparison of oxygen functional group doped and defect induced SWCNT and MWCNT for ORR activity. Therefore, the catalytic property is dependent on the dopant (oxygenated) concentration at the wall and is related to the increase in defects as well as ORR current. The intriguing wall structure of SWCNT permits high functionality in oxygenated species and reinforce superior stability in ORR than MWCNT.



Recent Publications

1. Subramanian P, Mohan R, Schechter A (2017) Unraveling the Oxygen-reduction sites in Graphitic-carbon Co-N-C Type Electrocatalyst Prepared by Single-Precursor Pyrolysis, ChemCatChem 9:1969-1978

Biography

Roopathy Mohan has pursued her Master's Degree in Chemistry from National Institute of Technology Tiruchirappalli, India. Currently, she is a Doctoral student in Fuel cell and Electrochemistry group, Ariel University, Israel under the supervision of Prof Alex Schechter. Her research work mainly focuses on the study of carbon-based oxygen reduction electrocatalysts treated by cold plasma. She has her expertise in designing plasma assisted carbon supported metal free and metal nitrogen and carbon (MNC) catalysts for electrochemical oxygen reduction reaction.

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