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Support less Ag-Rh bimetallic nanostructures as efficient cathodic electro catalyst for di oxygen reduction in alkaline fuel cells

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The non-platinum d-block elements can be employed as ORR electrocatalysts due to their catalytic activity which help us to reduce or replace the usage of expensive precious metal catalysts in alkaline fuel cells. A number of cathode electrocatalysts are available such as non-platinum metals (Ag, Au, Pd, etc.) and the non-noble metals (Fe, Co, Ni, Cu, etc.) but they either suffer from low activity or poor stability. Among the noble metal electrocatalysts, Ag is relatively inexpensive (ca. 1% the price of Pt), abundant and reasonably active catalyst with moderate stability and therefore, Ag is an attractive choice for enhancing the kinetics of oxygen reduction in alkaline medium. The redox potential of Rh3+ to Rh is 0.76 V whereas the redox potential of Ag+ to Ag is 0.8 V. The electrochemical activity of pure Rh is very poor but it could provide the additional stability when mixed with other catalyst materials. Hence, formation of Ag-Rh nanostructures may provide to be useful approach for improving the stability in a cost effective way. Silver-rhodium (Ag-Rh) nanostructured electro catalysts were synthesized by one step chemical reduction method and used to catalyze the oxygen reduction reaction (ORR) in an alkaline medium. The crystalline nature was ascertained by x-ray diffraction (XRD), elemental composition was estimated by energy dispersive spectroscopy and morphology was confirmed high resolution transmission electron microscope. The electrochemical properties were studied by cyclic and linear scan voltammetry techniques under hydrodynamic conditions. The supportless Ag-Rh catalyst exhibited a good catalytic activity for ORR and the quantified values in terms of higher mass and intrinsic activities were determined to be 951.7 mA/mg and 1.45 mA/cm^2 respectively. Accelerated durability test revealed that the catalyst could withstand nearly 7000 potential cycles with 5% increment in limited current density while retaining nearly 70% of its initial electrochemically active surface area. This study indicates the superior activity and stability of Ag-Rh (compared to Ag-Rh/VC) undoubtedly places it as one among the promising electrocatalysts for ORR in alkaline medium.

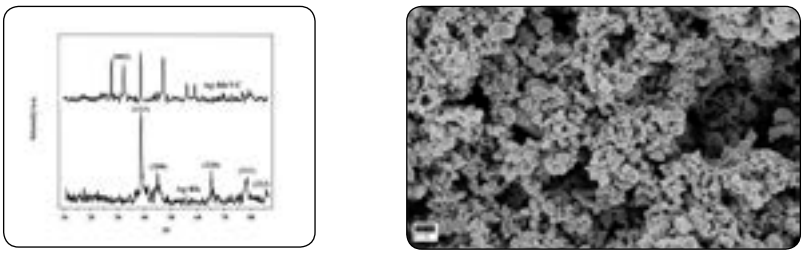

Fig. 1 XRD patterns of supportless and VC supported Ag-Rh catalyst & SEM image of Ag-Rh catalyst.

Recent Publications:

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4. Narayanamoorthy B, Balaji S, Sita C, Pasupathi S, Eswaramoorthy M, Il-Shik Moon (2016) Enhanced Intrinsic Activity and Stability of Au-Rh Bimetallic Nanostructures as a Supportless Cathode Electrocatalyst for Oxygen Reduction in Alkaline Fuel Cells, ACS Sustainable Chemistry and Engineering, 4:6480-6490.

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Biography

Il Shik Moon is working as full Professor at Sunchon National University, Suncheon, South Korea. He has over 18 years of experience on the electrochemically assisted removal of liquid and air pollutants at electro-scrubbing process and its design development sector. His credentials include a Master of Engineering (ME) in Chemical Engineering, and Bachelor of Engineering (BEng) in Chemical Engineering. His expertise includes desalination using DCMD (direct contact membrane desalination) with modelling. Currently, he has colloborate work at Crandfield University, UK, for CO_2 removal by electro-scrubbing process.

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Notes: