Poster Presentation

MS080.P02

Nanoceria supported NrGO as highly stable electrocatalyst for oxygen reduction

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Today, the world is facing a severe challenge due to depletion of traditional fossil fuels. Scientists across the globe are working for solution that involves a dramatic shift to practical and environmentally sustainable energy sources. High-capacity energy systems, such as metal–air batteries, fuel cells, are highly desirable to meet the urgent requirement of sustainable energies. Among the fuel cells Direct methanol fuel cells (DMFCs) are recognized as an ideal power source for mobile applications and have received considerable attention in recent past. In this advanced electrochemical energy conversion technologies Oxygen Reduction Reaction (ORR) is of utmost importance. However, the poor kinetics of cathodic ORR in DMFCs significantly hampers their possibilities of commercialization. The oxygen is reduced in alkaline medium either through a 4-electron (equation i) or a 2-electron (equation ii) reduction pathway at the cathode as given below.

$O_2 + 2H_2O + 4e^-$ .... $4OH^-$ ....(i)

$O_2 + H_2O + 2e^-$ .... $OH^- + HO_2^-$........................(ii)

The sluggish kinetics of ORR, demands high loading of precious metal-containing catalysts (e.g., Pt), which unfavorably increases the cost of these electrochemical energy conversion devices. Therefore, synthesis of active electrocatalyst with increase in ORR performance is need of the hour. In the recent literature there are many reports on transition metal oxide (TMO) based ORR catalysts (Co, Mn, Cu, Fe oxides) for their high activity. It was found that 2D graphene layer having high electrical conductivity, large surface area and excellent chemical stability, appeared to be an ultimate choice as support material to enhance the catalytic performance of bare TMOs. TMOs are also having drawbacks like low electrical conductivity, which seriously affects the electron transfer process during ORR. Also during the practical test for some of the synthesized electrocatalysts methanol crosses over the electrolyte membrane and contaminate the cathode compartment which abruptly disturbs the ORR process. So methanol tolerant capability of ORR catalyst is another important factor needs consideration prior to practical application.

Here we are reporting the synthesis of CeO_2/NrGO nanocomposite via single step microwave solvothermal method which displayed very good oxygen reduction activity with nearly four electron transfer pathway in alkaline medium, which is similar to commercial Pt/C. Furthermore, the CeO_2/NrGO exhibit superior electrochemical stability and methanol tolerance capability to that of commercial Pt/C. Growth of CeO_2 on graphene surface has been discussed.

1. Soren, S. et.al. (2016) RSC Adv. 6, 77100-77104.
2. Huang, X. et.al. (2015) Science 348, 1230-1234.
3. Suntivich, J. (2013) Nat. Chem. 3, 546–550.

Keywords: Electrocatalyst, ORR, Graphene