

Pt/NbC-N electrocatalyst for use in Proton Exchange Membrane Fuel Cells

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Fuel cells are electrochemically devices which can transform the energy of chemical reactions directly into electrical energy and heat. They are situated at the centre of a hydrogen based society. During the last decade, fuel cells have received increasing attention due to their capability of producing electrical energy and heat in an emission free manner. Even though there are a couple of fuel cell types, the most promising one is represented by the Proton Exchange Membrane Fuel Cells (PEMFC) operated at low temperatures (approx. 80⁰ C). One of the most expensive components in a PEMFC is represented by the electrocatalyst which is a platinum group metal based [1]. The state-of-the-art fuel cell requires approx. 0.5 mg cm⁻² electrode [2] which needs to be drastically reduced due to cost and Pt scarcity [3]. In addition to these, recent studies have showed that the deployment of such a technology is limited by Pt dissolution [4], which is one of the many mechanisms for electrocatalyst degradation along with particle agglomeration, particle detachment and carbon support corrosion [5].

Niobium carbide-nitride was synthesized by a simple urea glass route. This was further analyzed and used as Pt catalyst support. XRD was used to determine the structure of the substrate while XPS was used to show the interaction between the Pt and the Nb based substrate. Pt and NbC-N particle size was estimated using Scherrer formula from the XRD pattern. The platinized substrate was tested for the electrochemical reduction of oxygen using a rotating disk electrode. A commercial catalyst with 20 wt.% Pt/C was used as a reference sample for comparing the specific and mass activity. The Pt/NbC-N electrocatalyst was cycled for 5000 cycles at 250 mV s⁻¹ from hydrogen adsorption/desorption to the Pt oxide region. The compound is not active for ORR and there is no difference in mass activity compared to the commercial 20 wt.% Pt/C.

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References

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