SYNTSHESIS OF PLATINUM MODIFIED NANOCARBON CATALYSTS FOR FUEL CELL APPLICATION

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As a promising chemical to electrical energy conversion tool, the fuel cell has started to gain traction in the energy market. Owing to its high conversion efficiency and clean working principle with high energy density output, the technology holds the potential to replace fossil fuel-based energy sources. However, among the bottlenecks of the fuel cell industry, the high cost of catalyst material can be considered as the key obstacle. Platinum-based electrocatalysts with carbon support (shortly Pt/C) are often used to increase the speed of the reactions for both electrodes of the cell. Due to the rare and expensive group of metals used in the catalyst for oxygen reduction reaction (ORR), the overall cost of the fuel cell stack slows the commercialization process. One of the suggested ways to improve this situation is reducing the amount of Pt used in the catalyst or achieving enhanced catalytic activity with the same amount of Pt loading [1].

In this work, the influence of carbon support pre-treatment on the final catalyst properties has been studied using vulcan carbon (shortly XC-72R) as the support material. For this purpose, catalyst samples with different treatment pathways (H_2O_2 and HNO_3 treatments) were synthesized via the polyol method using ethylene glycol. Next, in order to gain insight into the pre-treatment effect by comparison, the same type of synthesis was conducted for two additional samples to obtain catalysts with non-treated XC-72R and N-doped XC-72R (also non-treated but doped with polyvinylpyrrolidone and dicyandiamide). Finally, commercial Pt/C catalyst with 20% Pt loading was used as a benchmark for overall differentiation.

After conducting material characterization and other measurements, it was concluded that H_2O_2 treatment of vulcan carbon resulted in a substantial increase in the catalytic activity of the final sample while HNO_3 treatment was not associated with desired electrochemical activity towards ORR. As the next step the loading of Pt activity on the commercial and other carbon carriers shall be optimized towards the ORR via this method.

References

1. J. Wee, K. Lee and S. Kim, "Fabrication methods for low-Pt-loading electrocatalysts in proton exchange membrane fuel cell systems", Journal of Power Sources, vol. 165, no. 2, pp. 667-677, 2007. Available: 10.1016/j.jpowsour.2006.12.051

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