

Pt-decorated graphene foam for electrochemical oxygen reduction with high mass activity

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Proton exchange membrane fuel cells are a potentially important technology for transport, stationary, and portable energy applications due to e.g. their high efficiency, and rapid response. However, the high cost of the platinum catalyst, and deterioration of the electrocatalyst layer remain obstacles to more wide-spread commercialization.

Graphene is a single atomic layer carbon material, isolated in 2004. It has received great interest due to the high strength, large surface area, and high thermal and electronic conductivities.^[1] These promising properties mean that graphene can be applied in various fields, and especially in electromechanical systems, hydrogen storage, and energy conversion / storage.^[2] In particular, graphene is a promising material for use as an electrocatalyst support in PEMFCs.^{[3][4]}

Defective graphene foam was prepared by thermal decomposition of sodium ethoxide. After sonication, washing, and pyrolysis under nitrogen and/or hydrogen atmosphere, the graphene foam has large surface area of >1500 m²/g, which is higher than the commercial graphene or carbon black (Vulcan). SEM observation shows that the graphene foam has highly porous, three-dimensional structure. We utilize this graphene foam as electrocatalyst support material for PEMFCs. Through cyclic voltammetry and oxygen reduction reaction analysis, we observe that the graphene foam has large electrochemical surface area (ECSA) of 100.7 m²/g, and mass activity of 176.1 mA/mg, both of which are higher than for Pt-decorated carbon black. The large ECSA and high mass activity of platinum-decorated graphene foam make it as potential catalytic support material for PEMFCs.^{[5][6]}

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