Highly Ordered Pt-Np Catalyst from Self-Assembly of Block Copolymer and Its Durability in Fuel Cell Application

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Employing platinum-nanoparticle (Pt-Np) arrays with highly ordered and uniform arrangements of Nps in fuel cell is a possible approach to reduce the Pt-Np aggregation and improve catalyst durability during catalyst functioning. While the current methodologies for Pt-Np catalysts' synthesis can hardly achieve the homogeneously distributed Pt-Np layer due to the difficulty of control over the growing/located sites of Pt Nps precisely on carbon supporters. In this work, highly uniform and ordered Pt-Np arrays supported on carbon paper are prepared by pattern formation based on the self-assembly of PS-P2VP block copolymers (BCs). Cyclic voltammetry (CV) test of the arrays and the endurance test of the corresponding fuel cell indicate that, due to the absence of the Pt-Np aggregation, no significant performance loss is caused after 10000 cycles of CV and 100-hour running of the fuel cell. The aggregation can be successfully overcome by the quasi-homogeneous spacing distribution, which leads to higher electrocatalytic stability and better catalyst durability compared to the commonly used Johnson Matthey Pt/C commercial catalyst with the same Pt loading. After the endurance test, the Pt-Np arrays show almostly invariable size and spacing distributions, it has great potential in improving fuel-cell lifetime. The BC route is a promising strategy to achieve ultra-long-life and high- efficient functioning of the fuel cell.

Keywords: Pt-NP arrays, Spacing distribution, BC route, Cathodic catalysts, Fuel cell

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