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Perspectives on mass production of carbon supported Pt-based electrocatalysts for proton exchange membrane fuel cells

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ABSTRACT

Proton exchange membrane fuel cells (PEMFCs) have launched the process of extensive commercialization after decades of protracted and unremitting efforts. To recover the post-pandemic economy and overcome climate issues, PEMFC is being given an increasing role as one of strategies. However, the performance, cost, and durability still are the primary challenges PEMFCs need to overcome in order to be able to compete with incumbent technologies and Li-ion batteries. One promising approach is to improve the performance and durability of carbon supported Pt-based electrocatalysts that have been considered as the best electrocatalysts among the electrocatalysts available, and thus decreasing the loading, consequently the performance, cost, and durability of PEMFCs. In recent decades, plenty of highly active and stable carbon supported Pt-based electrocatalysts have been rationally designed and successfully synthesized by controlling the size or shape, and optimizing the carbon supports. However, most synthesis systems are only at the laboratory-level and the commonly used electrocatalysts in practical application are still Pt/C without definite morphology. There still lack methods for mass production of carbon supported Pt-based electrocatalysts with size and shape control. Herein, some viewpoints on how to promote mass production of carbon supported Pt-based electrocatalysts are suggested after analyzing the experimental details, e.g., the selection of materials, the loading methods of Pt-based electrocatalysts onto carbon, the reaction conditions, the post-synthesis treatment methods as well as their impacts on the prepared electrocatalyst, which are very important to better control the size and shape, decrease the manufacturing cost of the electrocatalysts, and promote the development of the feasible reaction systems for mass production. The functionalization of carbon support could boost the performance and durability of supported Pt-based electrocatalysts, but the potential of functionalization of carbon still needs to be further developed. From the points of environment and economy, one-pot synthesis is favored to simplify the synthesis process compared with *ex-situ* mixing method; the aqueous system (cheap and green) or the system with minimal use of organic solvent are superior to the organic reaction system; decreasing the use of organic ligands is preferred to simplify the post-synthesis treatment process, which are beneficial to promote the mass production of carbon supported Pt-based electrocatalysts.