

Template Fabrication of Mesoporous Metal Nanospheres for Electrochemical Applications

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Recently, a resurgence of interest in unsupported (or self-supported) Pt and Pt-based catalysts for proton-exchange membrane fuel cells has occurred. Templated synthesis using mesoporous silica nanoparticles (MSNs) with 3D-interconnected mesopores as hard template is one of the most versatile methods to prepare ordered Pt and metal mesostructures. A template having smaller pore size is preferred to produce metals with smaller diameter and higher surface area. In this contribution, our recent studies on the formation of various MSNs (MCM-41, MMT-1, MCM-48) in dilute surfactant solutions will be first briefly introduced. MCM-48 MSNs with 3D-interpenetrating mesopores were applied to fabricate Pt replica nanospheres by a new method involving molten salt impregnation and low-temperature H₂ reduction. The high-surface-area ordered mesoporous Pt nanospheres have a large fraction of {110} facets and exhibit high activity for the oxygen reduction reaction (ORR) owing to the facet-dependent activities and the 3D-interconnected mesoporosity.

Keywords: mesoporous silica nanospheres; mesoporous Pt nanospheres; nanocasting; electrocatalysis

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