Low-cost, high-performance electrocatalysts for polymer electrolyte membrane fuel cells

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Pt-based electrocatalysts offer good performance when applied to low-temperature fuel cells, including polymer electrolyte membrane fuel cells (PEMFCs) and direct methanol fuel cells (DMFCs). However, the use of Pt makes these fuel cells expensive to produce. Many attempts have been made to reduce the amount of Pt used in
fuel cell electrodes. One method involving the alloying Pt with transition metals has been extensively studied with the objective of enhancing electrocatalytic activity and reducing the Pt content in catalysts. Such alloying methods, however, have not satisfactorily reduced the Pt loading. Reports on the use of non-noble catalysts such as transition metal chalcogenides, oxides, and macrocycles as alternatives to Pt have shown that their electrocatalytic activities are much lower than Pt. The surface modification of metal nanoparticles has been suggested to be a promising candidate for minimizing the amount of Pt used and such modification has been realized by the formation of core/shell structures using chemical, electrochemical, and surface-segregation methods. In this presentation, syntheses of core/shell structured catalysts formed by using chemical and surface-segregation methods and their electrochemical activities will be covered. Au or Ir elements have been used as core materials while Pt or Pt alloys have been used as shell materials.

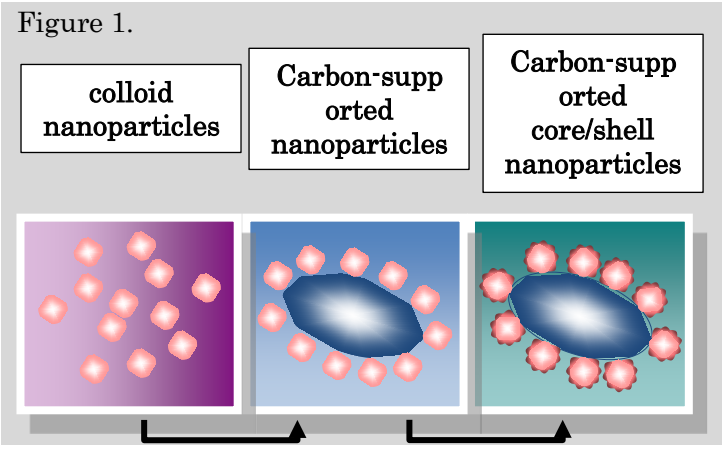

Fig. 1. A simple description of chemical reduction procedure for the formation of the core/shell structure.

A chemical reduction method that has been used for the formation of the core/shell structure is described in Figure 1.

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