Synethesis of various Ag-based electrocatalysts for fuel cell applications via plasma discharge in solution

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Ag is considered to be a promising electrocatalyst since it is roughly 100 times cheaper than Pt and is more stable than Pt in base. However, their synthetic route has been still issued because the synthesis of Ag nanocrystalsis mostly performed by a chemical method. Recently, a method for the synthesisof the Ag nanocrystals by means of plasma discharge in liquid phase isintroduced and plasma discharge in liquid phase is an attractive method for the synthesis of nanoparticles because it is faster (microseconds), simpler (one-step method) and more cost-effective (only requiring an ion source) than traditional colloid methods. In this paper, reported was the preparation of the Ag-based electrocatalysts (*e.g.* Agnanowires, nanodendrites, and $Ag@Co_3O_4$ core-shellnanocrystals) using bi-polar pulsed plasma discharge in water forcatalytic oxygen reduction and ethanol oxidation in alkaline solutions. The Ag nanowires and nanodendrites were achieved bytailoring the reduction kinetics with adjusted electron densities in plasma. From the linear sweep voltammetry, the specific activity of Ag nanowiresexhibited the 2.5 times higher than Ag nanodendrites, and the electron transfer number was calculated to be 3.83, which is the indicative of a four-electronORR pathway. For the $Ag@Co_3O_4$core-shell hybrid nanostructures, it was found that the reactive oxygen species generated from plasma-assisted decomposition of water molecules played an important role in controlling the phase structure of the nanoparticles. The electrochemical measurements for oxygen reduction reaction revealed that the electrocatalytic activity of the $Ag@Co_3O_4$ core-shell nanocrystals were higher than that of pure Ag and Co_3O_4nanoparticles.

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