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Preparation of Catalyst-Doped TiO2 Nanotubes by Single Step Anodization and Potential Shock

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Abstract : Titanium oxide nanotubes have attracted great attention because of its photocatalytic activity and large surface area. For enhancing electrochemical properties, catalysts should be doped into the structure because titanium oxide nanotubes themselves have low electroconductivity and catalytic activity. It has been reported that Ru and Ir doped titanium oxide electrodes exhibit high efficiency and low overpotential in the oxygen evolution reaction (OER) for water splitting. In general, titanium oxide nanotubes with high aspect ratio cannot be easily doped by conventional complex methods. Herein, two types of facile routes, namely single step anodization and potential shock, for Ru doping into high aspect ratio titanium oxide nanotubes are introduced in detail. When single step anodization was carried out, stability of electrodes were increased. However, onset potential was shifted to anodic direction. On the other hand, when high potential shock voltage was applied, a large amount of ruthenium/ruthenium oxides were doped into titanium oxide nanotubes and thick barrier oxide layers were formed simultaneously. Regardless of doping routes, ruthenium/ ruthenium oxides were homogeneously doped into titanium oxide nanotubes. In spite of doping routes, doping in aqueous solution generally led to incorporate high amount of Ru in titanium oxide nanotubes, compared to that in non-aqueous solution. The amounts of doped catalyst were analyzed by X-ray photoelectron spectroscopy (XPS). The optimum condition for water splitting was investigated in terms of the amount of doped Ru and thickness of barrier oxide layer.

Keywords : doping, potential shock, single step anodization, titanium oxide nanotubes
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