

## Construction of Ultra-thin Pt Layers on Ni Substrate for Highly Efficient Oxygen Reduction Reaction Catalysts

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In order to construct highly efficient and low-cost electrocatalysts for oxygen reduction reaction (ORR), ultra-thin Pt layers prepared on the Ni substrate is expected as one of the best electrocatalysts for ORR, because of the surface electronic energy effect and also because of using cheaper Ni as a substrate. However, it is difficult to electrochemically deposit Pt, which is a noble metal, on Ni which is a base metal. In this study, using self-termination phenomenon of Pt,<sup>1,2</sup> we constructed ultra-thin Pt layers on the Ni substrate in the pH-controlled electrolyte solution, evaluated their thickness by x-ray photoelectron spectroscopy (XPS), and then discussed the relationship between thickness of Pt layers and electrocatalytic activity for ORR.

After the surface oxide-free Ni polycrystalline substrates were prepared by mechanically polishing and electrochemically etching, ultra-thin Pt layers were constructed on them by using self-termination of Pt, *i.e.*, by dipping them at -0.60 V (vs. Ag/AgCl) ~ -0.64 V for several hundreds seconds in the 1 M NaCl electrolyte solution with pH = 8.0.<sup>1-3</sup> After washing them with ultra-pure water, the electrochemical characteristics and surface analyses of the samples were evaluated by the electrochemical and XPS measurements, respectively.

The more positive the electrodeposition potential of Pt and the longer the electrodeposition period, the more Pt was electrodeposited on Ni. However, the smaller the amount of the electrodeposited Pt, that is, the thinner the Pt layer on Ni, the higher the electrocatalytic activity for ORR. Therefore, the present results suggested that the thinner the Pt layer on Ni, the greater the effect of the surface electric energy and then the higher the electrocatalytic activity. However, if the Pt layer was too thin, the electrocatalytic activity would decrease during the experiments. This indicates that the underlying Ni seemed to electrochemically dissolve into the electrolyte solution. Therefore, it was found that it is necessary to construct the Pt layers, which have an optimum thickness so that the electrocatalytic activity is high and Ni does not dissolve.

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