Closely Interacted Pt-SnO_2 Electrocatalysts for Methanol Oxidation

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Polymer electrolyte fuel cells (PEFC) have drawn extensive attention because of their high efficiency, high power density, and zero emissions. The low operation temperature and quick startup make PEFC a promising power for automotive applications, which can alleviate green-house gas emissions. Methanol is a common chemical in liquid phase at room temperatures and can be produced from many resources. It has a high energy density (6 kWh/kg), involving 6 electrons in the complete oxidation to CO_2. [1]

However, the sluggish kinetics of methanol oxidation reaction (MOR) imposes a voltage loss of more than 0.3 V in a practical PEFC. [2] The Pt catalysts are easily poisoned by the reaction intermediates (mainly CO) of MOR. Consequently, numerous efforts have been devoted to mitigate the poisoning of Pt. Alloying of Pt with a transition metal has been proved be an effective method, with PtRu binary catalyst being the most active one. [3] However, Ru is an expensive noble metal and quite active in acidic media. The addition of metal oxides as co-catalysts has also been investigated [4-10]. Among various metal oxides, tin oxides are extensively investigated due to its high electrical conductivity and high electrochemical stability in acidic media.

Here we present a Pt-SnO_2 hybrid catalyst supported on carbon black (Vulcan XC72), made in a novel process with a control over the interfaces. In this catalyst, Pt and SnO_2 interact closely with each other. The X-ray diffraction (XRD) patterns, as presented in Fig. 1, indicate the successful deposition of Pt and SnO_2 nanoparticles on the carbon support. The obtained Pt-SnO_2/C hybrid catalyst shows a superior activity over Pt/C toward MOR, with a much lower onset potential and higher specific activity (Fig. 2). Detail results will be presented.

References

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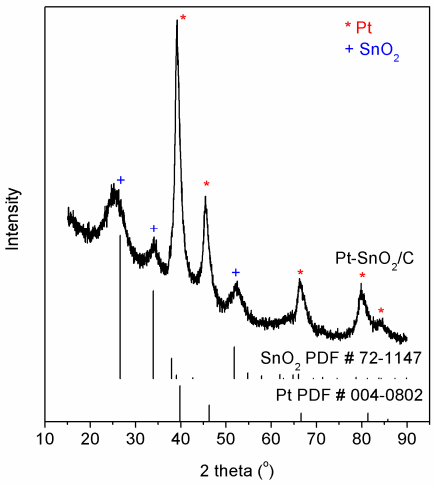

Figure 1. XRD patterns of synthesized Pt-SnO_2/C.

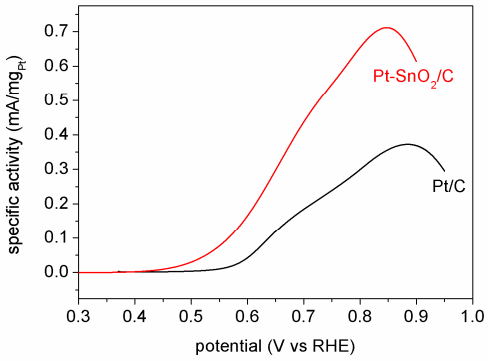

Figure 2. The specific activities of Pt/C and Pt-SnO_2/C toward MOR in the solution of 0.1 M $HClO_4$ and 1 M methanol at 1 mV/s and 25 °C.