Electrochemical performance improvement of the catalyst of the methanol micro-fuel cell using carbon nanotubes

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Abstract

Due to low working temperature, high energy density and low pollution, proton exchange fuel cells have been investigated under different operating conditions in different applications. Using platinum catalysts in methanol fuel cells leads to increasing the cost of this kind of fuel cell which is considered as a barrier to the commercialism of this technology. For this reason, a lot of efforts have been made to reduce the loading of the catalyst required on different supports. In this study, carbon black (CB) and carbon nanotubes (CNT) have been used as catalyst supports of the fuel cell as well as using the double-metal combination of platinum-ruthenium (PtRu) as anode electrode catalyst and platinum (Pt) as cathode electrode catalyst. The performance of these two types of electro-catalyst in the oxidation reaction of methanol has been compared based on electrochemical tests. Results showed that the carbon nanotubes increase the performance of the micro-fuel cell by 37% at maximum power density, compared to the carbon black.Based on thee-electrode tests of chronoamperometry and voltammetry, it was found that the oxidation onset potential of methanol for CNT has been around 20% less than CB, leading to the kinetic improvement of the oxidation reaction.The current density of methanol oxidation reaction increased up to 62% in CNT sample compared to CB supported one, therefore the active electrochemical surface area of the catalyst has been increased up to 90% by using CNT compared to CB which shows the significant rise of the electrocatalytic activity in CNT supported catalyst.

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