Fabrication of nickel and Pt-Ni particle/carbon paper electrocatalysts for electrooxidation of methanol in alkaline medium

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Introduction:

The development of alternative power sources is an important issue at present. Fuel cells are attractive sources of electrical power since they realize the direct conversion of chemical into electrical energy. Direct methanol fuel cells (DMFC) are expected to be the first fuel cells to provide a power source for portable electronic devices, such as mobile phones, laptop computers and advanced mobile electronic devices. Since it requires little additional equipment compared to the extensive gas process technology for methanol reforming, the fuel is best transported and converted into energy from the liquid state [1, 2]. However, the fuel cells could not reach the stage of commercialization due to the high cost which was mainly associated with the noble. Nowadays, all pre-commercial, low-temperature fuel cells use supported Pt and Pt alloys as electro-catalysts. Critical properties to consider when choosing an electro-catalyst support include its electrical conductivity, surface area, microstructure, corrosion resistance and cost. In order to reduce the amount of noble metal loading and also for enhancement of electro-catalytic activity of electrodes, there have been considerable efforts to increase the dispersion of the metal particles on the support. In the present study, we pretreated carbon paper and prepared electro-catalysts, and then characterized these supporting nickel and Pt-Ni electro-catalysts in order to find out better catalysts for DMFC. The electro-activity of these electro-catalystsfor the methanol oxidation in alkaline solutions was studied by different electrochemistry methods.

Materials, methods and Apparatus:

Methanol (Merck, 99.8% purity) and KOH (Merck, 84% purity) were used as received. All other chemicals were of analytical grade and used without further purification. Distilled water was used throughout. The electrochemical experiments were performed in a three-electrode cell arrangement. A platinum sheet was used as counter electrode, while all potentials were measured with respect to Ag/AgClelectrode. Electrochemical experiments were carried out using Zahner and EG&G PARSTAT 2263 Advanced Electrochemical systems.

Result and discussion:

Nickel and Pt-Ni particles were deposited on the carbon paper by cyclic voltammetry and electrodeposition method. SEM images of new electro-catalysts show that the nickel and Pt–Ni particles are distributed on the surface of the carbon paper. In order to compare Ni/carbon paper with Pt-Ni/carbon paper, the CV method was used to estimate the behavior of the electro-catalysts. The results indicate these improve the electro-catalytic activity for methanol oxidation greatly and confirmed the good electro-catalytic activity and stability of these electro-catalysts.

Conclusion:

Ni/carbon paper with Pt-Ni/carbon paper with good electro-catalytic property has been successfully fabricated. The morphology and surface analysis of electro-catalysts were investigated by SEM and EDX, respectively. The electro-catalytic activity oftheseelectro-catalysts for methanol oxidation was evaluatedby various electrochemical methods. These electro-catalysts showed high currents formethanol oxidation and good electro-catalytic activity. So it can be said that this electro-catalysts show great prospect in the applications of alcohol fuel cells.

Reference:

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