Novel 3D Vertically Aligned Platinum Nanowire Array as Electrocatalysts for Direct Methanol Fuel Cells

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Abstract

In recent years, extensive amounts of research have been done on developing high performance electocatalysts for direct methanol oxidation fuel cells due to its high performance efficiency and environmentally friendly benefits. However, most of the catalysts require alloy of many noble metals such as palladium and gold, involve with complicated preparation methods, and encounter severe catalyst poisoning. In our research, a highly efficient electrochemical catalyst towards methanol oxidation, based on vertical Platinum (Pt) nanowire array, has been developed. The vertical Pt nanowire array was prepared by the electrodeposition method using AAO membrane. Nanowires with different roughness were synthesized by varying the plating current density, and the length of the nanowires were kept uniform by controlling the deposition time. This well aligned array makes it possible for every nanowire to have full contact with the analyte without the nanowires overlapping, and with the help of the rough surfaces, each individual nanowire is able to have a higher surface to volume ratio that further facilitates the reaction. This novel 3D structure showed several advantages such as avoiding the CO poisoning, fully oxidizing the reactants to the desired products, and increasing the electrochemical activity. The results indicate that the 3D electrocatalyst is able to achieve very high performance for generating electron sources for the direct methanol fuel cell; it is also a very promising catalyst for reactions taking place in a different analyte such as ethanol in a basic environment.