Carbon Nanotube Electrodes for Methanol Fuel Cells

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We show for the first time a simple method of electrophoretic deposition, which gives stable films of carbon nanotubes, on a number of conducting surfaces including Nafion membranes and optically transparent electrodes (OTE). We can reproducibly obtain films of varying amounts of carbon nanotubes on these electrodes which can then be used in both oxygen reduction and methanol oxidation. The CNT based electrodes show superior performance compared to plain platinum electrodes.

Understanding the kinetics of methanol oxidation on CNT and comparing the results with pure platinum can establish the electrocatalytic activity of carbon nanotubes towards methanol oxidation. The onset potential for the methanol oxidation is at a much lower potential for the CNT/Pt electrode (200 mV vs. SCE) than the pulsed Pt electrode (400 mV). This reduction of the onset potential for methanol oxidation reaction on an CNT/Pt electrode is comparable to the effect of alloying of ruthenium on platinum. This along with the enhancement of the anodic current suggests a catalytic role for CNT in promoting the methanol oxidation process.

We have also studied the performance of CNT as a methanol tolerant electro catalyst for oxygen reduction. We continue to observe an oxygen reduction current in the presence of methanol. The absence of methanol oxidation is an indication that the interference by methanol is minimal.

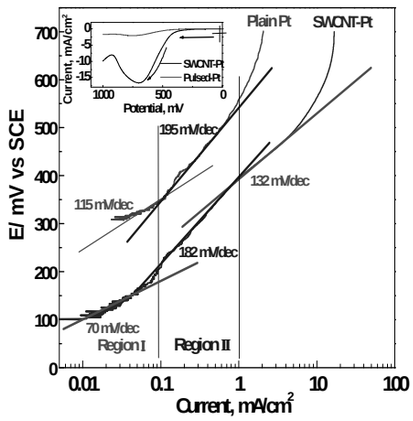

Figure 1: Comparison of the Tafel plot for the methanol oxidation on a pulsed Pt electrode and a CNT/Pt electrode. The loading of Pt in both cases was the same (0.1 mg/cm^2). The inset indicates the typical linear sweep voltammogram (LSV) for a CNT/Pt electrode and a bare Pt electrode (scan rate: 20 mV/s).

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