Novel 3D Tin Nano Structured Electrodes for Methanol Anodes in Fuel Cells

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The quest for high activity catalysts for fuel cells involves improving the catalyst materials and their utilization. Anodic oxidation of methanol fuel exhibit slow kinetic on the state of the art platinum (Pt). We hereby report a novel 3D anode based on three dimensional Tin (Sn) nanostructure, selectively decorated by Pt particles and reinforced by disordered carbon fibers. The Sn electrode was prepared by electrodeposition of Tin on Toray carbonized paper resulting in single phase β-Sn. Highly surface area dendritic "tree" shapes were formed by potentiostatic, galvanostatic and pulses of current or voltage. Pt is deposited selectively on the Sn surface via electro-less process to form thin layers with high surface area.

Several parameters controlling Sn deposition were studied including: applied potential, applied current, pulse duty cycle and electrolyte solution additives. The morphology of the Sn nanostructures was investigated during electrodeposition. Complementary EQCM was used to characterize the deposition, dissolution, passivation and activation processes of Sn nanostructures grown on gold electrode.

Direct electro-less deposition of Pt on Sn/SnO_2 surfaces occurs via metal exchange reaction. We have found that Pt can be directly reduced on the Sn surface by means of immersion in H_2PtCl_6 solution, driven by differences in standard redox potential of the metals. The effect of immersion time, concentration of platinum salt and additives were explored. The catalysts morphology and activity towards methanol oxidation will be reported.

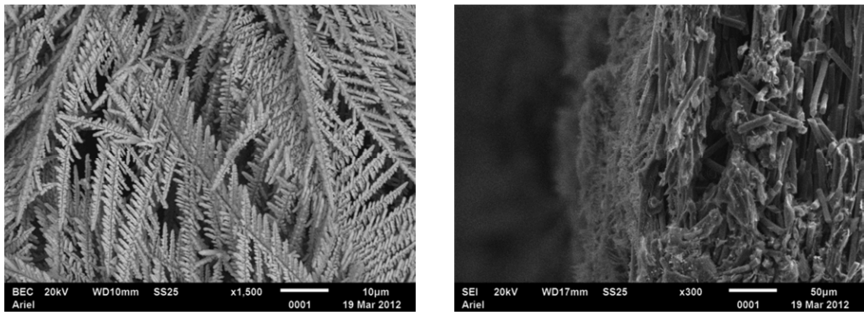

Figure 1. Tin dendritic nano-"trees" deposited on Toray carbonized paper (left) and cross-section view of this 3D electrode (right).