Graphene Supported Platinum Nanowire Arrays as High Performance Electrocatalysts

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With high energy densities and ease of fuel handling and storage, direct methanol fuel cells (DMFC) show great application potential as power sources for transportation and small electronics applications.[1] At the current state of DMFC technology however, their large scale implementation has been greatly hindered by the slow electrochemical kinetics occurring at the anode for the methanol oxidation reaction (MOR) and at the cathode for the oxygen reduction reaction (ORR), even on state-of-the-art platinum based catalysts. This results in limited device performance, along with high loadings of expensive platinum based catalyst required, a source of economic burden for the manufacture and marketability of DMFC products.

Recently, unique shape controlled Pt nanocrystals have drawn increasing research interests due to their improved catalytic activities and stability compared with traditional spherical Pt nanoparticle based catalysts.[2,3] However, synthesis of these nanostructured Pt materials generally requires utilization of large organic molecules to act as surfactants or structure directing agents. By extension, removal of these species is a stringent necessity, as they will contaminate and poison active Pt catalytic sites. Moreover, to be used practically in DMFC systems, it is required to incorporate the Pt materials with carbon supports using physical mixing methodologies. These techniques can be detrimental to the overall catalyst stability, and results in only minimal catalyst-support interactions and interconnectivity throughout the bulk of the catalyst layer.

Using a surfactant free, room temperature, aqueous based fabrication technique, [4,5] Pt nanowire arrays have been directly grown onto the surface of graphene support materials. In comparison to state-of-the-art commercial Pt/C catalyst, this turf-like catalyst structure (see **Figure 1**) shows enhanced electrochemical catalytic activity, particularly towards the oxidation of small organic molecules. Thus, these materials hold promise for use as advanced fuel cell catalysts, particularly in DMFCs.

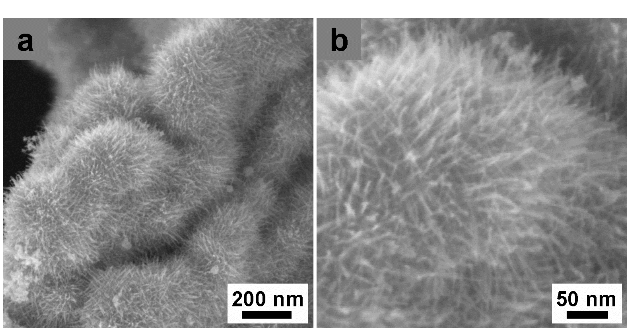

Figure 1. SEM images of platinum nanowire array on graphene composite structure.

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