BENEMÉRITA UNIVERSIDAD AUTÓNOMA DE PUEBLA

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"One-dimensional nanostructures for energy-related applications"

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Carbon nanotubes have been successfully employed as removable templates for the growth of a variety of one-dimensional (1D) nanostructures. Ceria (CeO_2) is a technologically important material due to its intrinsic structural and redox properties, which make it of high potential for catalytic and energy-related applications. Since small dimensions promote excellent consequences in catalytic applications, the controlled synthesis of nanoscale ceria materials is highly desirable. Ceria based nanomaterials have been prepared in different geometries and sizes including belts, wires, tubes and cubes. In this study, we report the synthesis and electrochemical properties of novel one-dimensional CeO_2-based catalysts consisting of multiwalled ceria nanotubes (CeO_2-NTs) decorated with platinum (Pt). The CeO_2-NTs were prepared by liquid-phase deposition method using multi-walled carbon nanotubes as template. Carbon nanotubes were removed by oxidation leaving behind multi-walled ceria nanotubes. Then, Pt was added to the multi-walled structure by a vapor-phase decomposition method. HR-TEM, XPS and SEM results revealed the presence of Pt as well distributed metallic particles of about 4 - 8 nm on the surface of the multi walled structure. However, Pt was also incorporated into the lattice of CeO_2-NTs resulting in a solid solution of the type $Ce_{1-x}Pt_xO_{2-\delta}$. Pt content was fixed at 10 and 20 wt%. The electrochemical performance was evaluated by cyclic voltammetry in 0.5 M H_2SO_4 and CH_3OH solution. The individual CeO_2-NTs promote lower anodic currents at 1.1 V vs. Ag/AgCl than conventional C-Vulcan reference electrocatalyst indicating their oxidation resistance. In addition, Pt/CeO_2-NTs showed higher catalytic activity in methanol oxidation than Pt/C-Vulcan. Thus, Pt/CeO_2-NTs exhibit not only high activity towards methanol oxidation but also stability in the anodic region.

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