Carbon Nanotubes and Nanocomposites for Fuel Cells, Methods for Fabrication and Fuel Cell Using the Same

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TECHNOLOGY DESCRIPTION

The fuel cell is an energy conversion device that produces electricity through the electrochemical reaction of a fuel and oxidative gas. Polymer electrolyte fuel cells, e.g., proton-exchange membrane fuel cells using hydrogen gas as fuel and direct methanol fuel cells, are clean energy sources with high power density and high energy conversion efficiency. They can replace fossil fuels and help reduce greenhouse gas emissions and pollution. Moreover, polymer electrolyte fuel cells can operate at ambient temperature and be miniaturized and sealed. As such they provide an attractive power generation option for vehicles, home use and portable applications in telecommunications, military equipment, medical equipment, space technology, and others. Increasing the energy density of polymer electrolyte fuel cells remains an important technological goal and much work continues towards developing improved electrodes, membranes and fuels. In particular, many attempts have been made to increase catalyst activity – which promote fuel cell chemical reactions – in the electrodes.

University researchers have developed advanced electrode materials with very large surface area to increase catalyst activity. The inventive approach is premised on the use of nanocomposites fabricated from aligned carbon nanotubes and dispersed nanoparticles of a metallic catalyst. Alignment of the nanotubes ensures their separation from each other at high densities (up to 10^{12} nanotubes/cm^2), thus increasing the nanotube circumferential surface area that is available for adhesion of catalyst nanoparticles. The surface area can be further increased by growing secondary nanotubes at an angle from the primary nanotubes, and tertiary ones from the secondary, to form tree-like nanostructures. In the invented nanocomposite electrodes, nanoparticles of the metallic catalyst, e.g., Pt, Pd and alloys, are uniformly distributed on the external walls of the nanotubes. The invention provides methods of fabricating the ultra-large surface area carbon nanotubes and the high reaction efficiency nanocomposites. It also provides a fuel cell which utilizes the nanocomposites in its electrodes and delivers improved energy conversion performance. This technology has patents pending and is available for licensing.

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OTHER INFORMATION

KEYWORDS

fuel cell, carbon nanotube, nanocomposite, fuel cell electrode, catalyst, surface area, polymer electrolyte membrane fuel cell, proton exchange membrane fuel cell

CATEGORIZED AS

- Materials & Chemicals
  - Nanomaterials
- Nanotechnology
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