FS4-5

Recent Key Materials Research on Hydrogen Storage and PEM-fuel Cell in Taiwan Power Company

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Abstract

Hydrogen could be produced by the electrolysis of water using electricity from wind power, photovoltaic or biomass. Then, hydrogen could be reacted with oxygen in fuel cells to regenerate electricity. In other words, hydrogen could be used as an energy carrier to transform the unstable renewable energy into base-loaded electricity by means of hydrogen production, storage and electricity regeneration. Component materials of both hydrogen storage and proton electrolyte membrane (PEM) fuel cell play a key role in the development of future new hydrogen energy technology.

Hence, the first part of this presentation is focused on hydrogen storage alloys (HSAs) as the following four categories：(a) preparation of alloys and testing on properties for hydrogen storage, (b) design and fabrication of a tentative (small-size) metal hydride tank by utilizing these hydrogen storage materials, (c)simulation, test and comparison to be made to study the effects of heat and fluid flow on hydrogen absorption/desorption rates, and (d) a large-size metal hydride tank to be proposed based on the performance of the tentative tank.

The second part of this presentation is focused on the synthesis, structural characterization of nano carbon fibers (NCFs), nano carbon tubes (NCTs) as well as hydrogenation behavior of these materials. Carbon materials were prepared by various processes including arc discharge, thermal chemical vapor deposition（CVD）as well as high density plasma enhance CVD. After the CNTs were produced, a post chemical treatment by using a special process could further increase hydrogen uptake to 3.23wt%. A hydrogen uptake of 6.5 wt% could be expected if the hydrogen pressure was increased from 5 to 12 MPa. The value of 6.5 wt% has been proposed by DOE of US as a criteria for using the hydrogen storage materials on electric vehicle.

Presently, PEM fuel cell represents the state-of-the-art FC technology. However, reduction in cost as well as increased durability and efficiency still remained as technical challenges. The third part of this presentation is focused on the synthesis, structural characterization of the novel membranes of PEM fuel cell as well as evaluation on their electrochemical properties.