Project Report 2013

Carbon-based nanostructures for hydrogen storage

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Objectives: short, medium and long term

The main focus of the specific project was the experimental study of an extensive series of sorbents with different structural and porous characteristics which were investigated for their solid-state hydrogen-storage capacity through physical adsorption processes, in an attempt to address the main classes of porous materials (carbon nanostructures, framework materials etc.) that are currently receiving attention as potential H2 stores. In this respect, both commercially available (carbon nanotubes, layered graphene, carbon black) and newly synthesized (carbon aerogels, exfoliated graphene oxide, metal-organic frameworks etc.) nanomaterials were systematically examined. The main aim of the experiments that were carried out in HYSORB was to investigate the H2 gravimetric capacity of all materials under different pressures (1-20 bar) and temperatures (77 - 298 K), as well as correlate the H2 storage capacity with the textural properties of the porous materials.

Brief summary of work carried out

The experimental methodology was based on both the structural characterization of all materials (10 types in total) as well as the evaluation of their hydrogen storage properties. Their textural properties were determined by nitrogen adsorption at 77K; important parameters were extracted such as the BET specific surface area, the total pore volume and the pore size distribution. Additional methods such as X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Infrared Spectroscopy (IR), Thermogravimetric Analysis (TGA), were also employed in order to elucidate further their structural features. The hydrogen sorption behavior of each material was studied by systematic adsorption/desorption measurements at different pressures (0-20bar) and temperatures (77K-298K) using specialized low and high pressure volumetric systems.

Main achievements intended for publication

The specific experiments contributed to the correlation of the hydrogen storage properties of the examined materials with the respective structures and comprised a major part of the Master of Science thesis of Mr. N. Kostoglou (post-graduate student in the Mechanical and Manufacturing Engineering Department, University of Cyprus, Cyprus). Mr. N. Kostoglou defended successfully his thesis within May 2014. In addition it is planned to include the

obtained results in a publication to the International Journal of Hydrogen Energy (manuscript in preparation).

Difficulties encountered

None.

Further comments

None.