**Carbon Based Hydrogen Storage Materials**

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**Abstract:**

Hydrogen is an alternative source of energy due to its various advantages, such as higher energy density, non–polluting characteristics and renewable nature. This study intended to develop mesoporous templated carbon and graphene-based materials for solid state hydrogen storage. In this study, the low-cost alumina based mesoporous templates were developed and the efficiency was compared with that of templated carbons prepared using commercially available microporous zeolite and mesoporous silica gel templates. The effects of non-metal (nitrogen) and metal (platinum, palladium or nickel) doping on templated carbons were also investigated. The graphene-based materials were developed by chemical and thermal treatments of graphene oxide. The effects of exfoliation temperatures (200–500°C) and carrier gases (hydrogen, argon, or air) were studied. The effects of preparation conditions and incorporation of metals (platinum, palladium or nickel) were also investigated. The hydrogen storage properties of the prepared samples were determined at –196 °C at 25 or 30 bar using volumetric adsorption analysis. The heat of adsorption, reversibility and cycle stability of samples were also determined. The alumina based templated carbons were mesoporous (2–10 nm) having agglomerated tubular/noodle like structures. At –196 °C and 25 bar, the hydrogen uptake capacity for nitrogen doped surfactant modified alumina templated carbon was 3.9 wt.% which enhanced to 4.1 wt.% on co–doping with platinum and to 5 wt.%. on co-doping with palladium. The increase may be assigned to additional adsorption sites for hydrogen provided by dopants. Also, the highest heat of adsorption of 22.9 kJ/mol was obtained for the same sample. The chemically hydrazine reduced graphene oxide (RGO) had wrinkled layered, while thermally exfoliated graphene oxide samples had fluffy layered structure. The BET surface area was highest for RGO (461 m2/g), while O/C value was highest for EGO (Air). The exfoliation temperature of 300 °C was observed to be optimum. The maximum hydrogen uptake of 3.34 wt.% was obtained for EGO (Air) at –196 °C and 30 bar followed by that of RGO. The hydrogen uptake capacity was observed to increase with O/C ratio as the presence of highly electronegative oxygen may have facilitated the interaction with incoming highly electropositive hydrogen. On addition of palladium metal to RGO and EGO, the hydrogen uptake capacity was enhanced from 2.5 to 3.2 wt.% and 3.3 to 3.5 wt.% respectively at –196 °C and 30 bar.

**Biography:**

I am presently working as a postdoctoral research associate at University of Illinois Urbana-Champaign, Illinois, USA. Where, I’m involved in two projects funded by the U.S. Department of Energy; 1. Production of carbon nanomaterials and sorbents from domestic U.S. coal, 2. Development of coal-based supercapacitor materials for energy storage. I received my Ph.D. and master’s degree in chemical engineering from Indian Institute of Technology Guwahati, India, where I have developed low-cost templated carbons, graphene, silica materials and ZnO-based adsorbents for hydrogen storage, CO2 capture and desulfurization applications. I have contributed to 10 publications in peer-reviewed international journals, presented research work at 8 national and international conferences and attended 5 workshops. With that, I reviewed more than 80 research papers and I am serving as Editorial member of two research journals.

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