408h Heat of Adsorption of Hydrogen in Nanoporous Materials

S. B. Kayiran, F. D. Lamari, and S. Farhat

The adsorption of molecules in nanotube materials is of fundamental interest because gas storage and separation technologies can benefit from a better understanding of the sorption properties. The large hydrogen storage capacity provided by carbon nanotubes [Dillon *et al.* 1997] and graphite nanofibers accelerated the worldwide research and development of hydrogen storage in carbon materials. However, there have been few subsequent reports of such a large hydrogen storage capacity and the value is generally less than 4 wt.%. The factors that have been considered are the differences between estimation methods, their precision, sample purity, and the influence of a prior treatment [Kayiran *et al.* 2004]. Sample of single walled carbon nanotubes (SWNTs) produced by arc discharge method was analysed by various characterization techniques like scanning electronic microscopy, transmission electronic microscopy and specific surface area measurements. For quantitative estimates of SWNTs contents, the Li *et al.* 2004 criteria were used. Then the SWNT contents in the sample is found to be about 52 wt%. The hydrogen adsorption capacity of this material has been performed up to a pressure of 5 MPa and at three different temperatures of 293 K, 283 K and 278 K by using a gravimetric-volumetric method. The heat of adsorption was calculated by using the Vant Hoff isochore. The adsorbent is activated at 673 K and under secondary vacuum. The standard arc-evaporation reactor described in details in Farhat *et al.* 2001, was used to produce soots containing nanotubes. To improve the nanotube contents in the soot samples, only the soots deposited on the lateral reactor wall in front of the plasma zone and on the cathode holder was retained. For these experiments, the bi-metallic catalysts nickel and yttrium with the molar ratio of (C/Ni/Y 94.8: 4.2: 1) was used. These proportions were found to give the highest nanotube yield by Journet *et al.* 1997. The structural properties of sample are correlated to its gas adsorption capacity at different temperatures and its heat of adsorption is compared to the published ones in the literature.

Dillon. A.C., Jones K.M. , Bekkedahl T.A., Kiang C.H., Bethune D.S. and Heben M.J. "Storage of Hydrogen in Single Walled Carbon Nanotubes" Nature 1997,386; 377 Kayiran S.B.; Lamari, F.D.; Levesque, D. “Adsorption Properties and Structural Characterization of Activated Carbons and Nanocarbons” J. Phys. Chem. 2004, 108;15211 Li F., Wang Y., Wang D. and Wei F. "Characterization of single-wall carbon nanotubes by N_2 adsorption" Carbon 2004, Volume 42 (12); 2375-2383. Farhat S., Lamy de La Chapelle M., Loiseau A., Scott C.D., Lefrant S., Journet C. "Diameter control of single-walled carbon nanotubes using argon-helium mixture gases" J. Chem. Phys. 2001; 115(14);6752-9. Journet C., Maser W.K., Bernier P., Loiseau A., Lamy de La Chapelle M., Lefrant S., "Large-scale production of single-walled carbon nanotubes by the electric-arc technique" Nature 1997; 388(6644);756-8.