

## Project C-9: Hydrogen storage in single wall carbon nanotubes

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Hydrogen adsorption measurements on as-grown and modified SWNTs in a volumetric system (Quantachrome Autosorb-1), in a gravimetric system (IGA-001) and by an electrochemical method have been carried out. Adsorption temperatures of 77K and 298K have been used and a range of hydrogen pressure up to 20 bar was covered.

Good agreement is observed between Autosorb-1 and IGA-001 data. The electrochemical data show higher hydrogen adsorption values because adsorption occurs by a different mechanism involving an external energy supply. The maxima hydrogen adsorption values obtained are far from the DOE target, see Table 1.

Several SWCNT material activation processes such as oxidation and reduction have been tested. SWCNTs oxidation develops sample microporosity, increasing the hydrogen adsorption by 190 wt. % at 77K and by 25 wt. % at 298 K. SWCNT sample reduction leads to an increase of hydrogen adsorption of about 40 % at 77K, this increase being due to metal reduction and hydrogen spillover from the surface of the reduced metal to the surface of the SWNTs. Further evidence will be obtained by performing the hydrogen adsorption experiments at room temperature and higher hydrogen pressure.

**Table 1.** Comparative data of hydrogen adsorption for raw and activated SWCNTs obtained by the three techniques used.

Measurement technique	Temperature	S205		S205+350	
		p [mbar]	Hydrogen wt%	p [mbar]	Hydrogen wt%
Autosorb-1	77 K	1023	0.317	1023	0.924
	298 K	931	0.008	1034	0.012
IGA-001	77 K	992	0.175	1001	0.811
		19993	0.670	19996	1.390
	298 K	993	0.025	1000	0.013
		19996	0.073	20001	0.100
Electrochemical	293K	Room	0.08	Room	0.28