TEM PROJECT: NEODYMIUM/BORON ADDITION TO IRON CATALYSTS FOR CNTS

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TEM Couse Fall 2015

Catalysis of CNTs

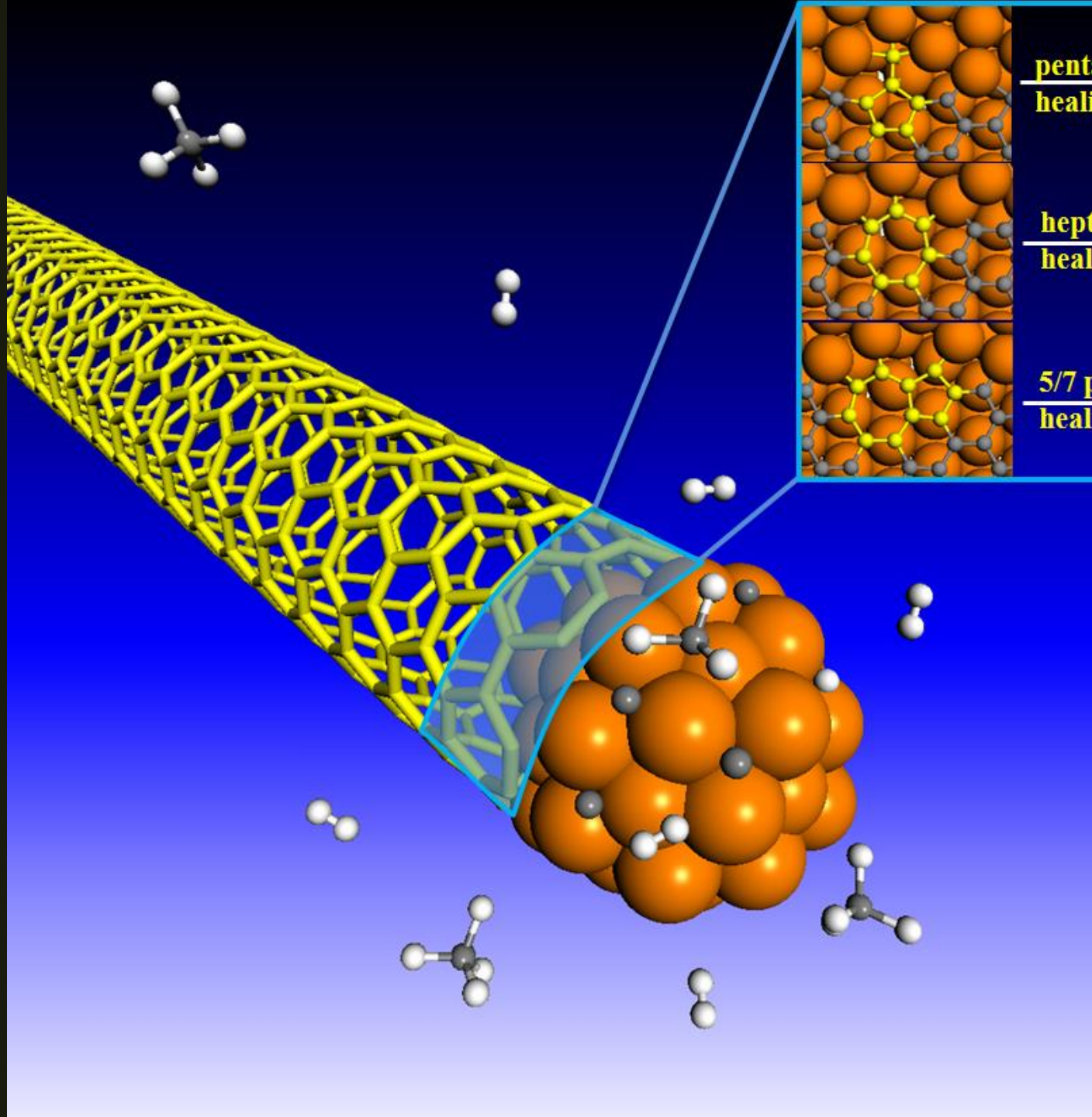
Carbon nanotubes are produced with metal catalysts

They can be supported or free metal particles

Typically magnetic metals are used (Ni, Co, Fe)

NdFeB alloys are also magnetic but have not been studied

We would like to see the effect of adding Nd/B to Fe based catalysts in order to observe changes in CNT wall number and diameter



http://news.rice.edu/2012/06/18/in-nanotube-growth-errors-are-not-an-option/

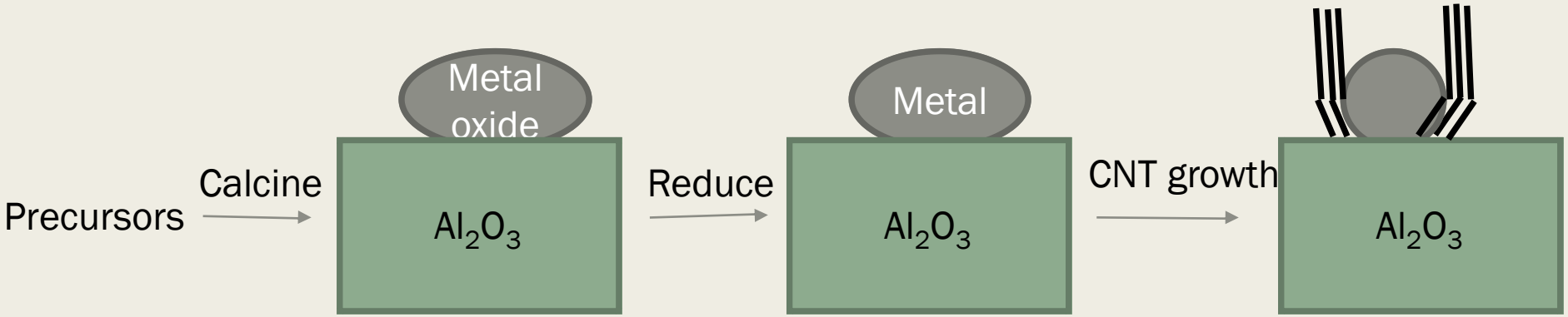
Metal cluster synthesis methods

- 12 Different Samples will be considered

Nd/B Doped Fe | Fe

Stages of Catalyst Synthesis

	Incipient wetness on Alumina with Nd/B Doped Fe	Nd/B Doped Fe without support	Incipient wetness on Alumina with Fe	Fe without support
After Calcination	NdFeB oxide/Al2O3	NdFeB oxide	Fe oxide/Al2O3	Fe oxide
After Reduction	NdFeB/Al2O3	NdFeB	Fe/Al2O3	Fe
After CNT growth	CNT NdFeB/Al2O3	CNT/NdFeB	CNT/Fe/Al2O3	CNT/Fe



TEM analysis

- Sample preparation will be 1 mg CNT/10 ml IPA sonicated at 20% amplitude for 1 hour, with 1 drop (~30 uL) on holey carbon grid, then evaporated
- Lattice parameters will be found and diffraction will be used to identify the crystal structure
- The number of walls for each tube as will as inner and outer diameters will be estimated and compared for each sample

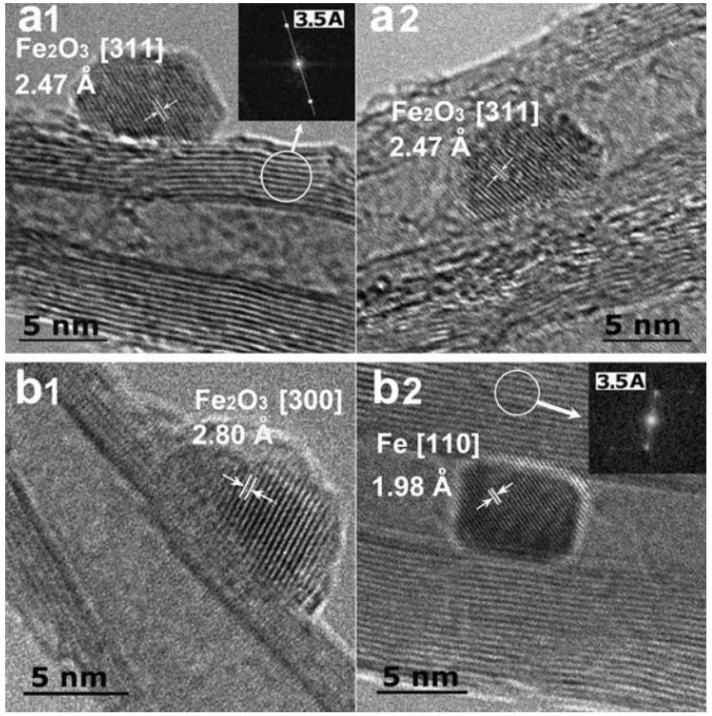
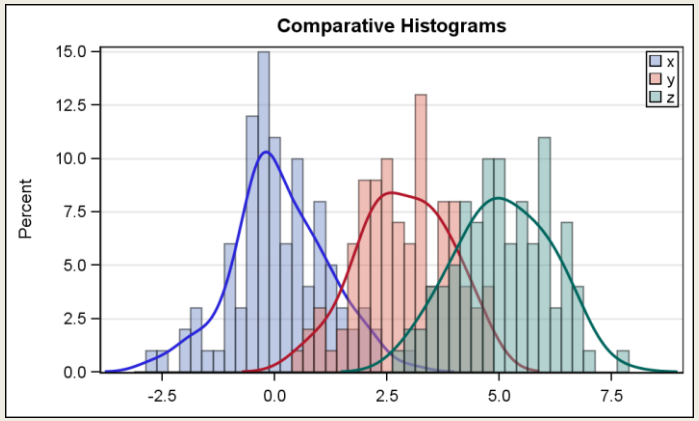


Fig. 6 *In situ* HRTEM images of Fe_2O_3/CNTs at (a) 20 °C and (b) 600 °C. (a1) and (b1) show outer while (a2) and (b2) inner particles with typical crystal planes.[20] Reprinted with permission from ref. 20.



http://blogs.sas.com/content/graphicallyspeaking/2013/11/21/comparative-histograms/

Chen, Wei, Xiulian Pan, Marc-Georg Willinger, Dang Sheng Su, and Xinhe Bao. "Facile autoreduction of iron oxide/carbon nanotube encapsulates." *Journal of the American Chemical Society* 128, no. 10 (2006): 3136-3137.