Molecular Sieve Encapsulated Single Walled Carbon Nanotubes

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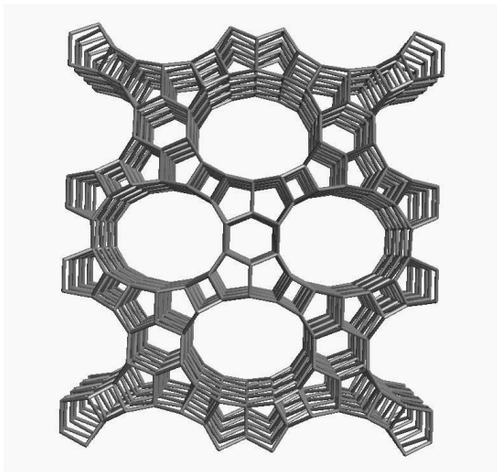
Molecular sieves comprise a family of nanoporous metal oxides that possess well defined pore architectures. The encapsulation of single walled carbon nanotubes (SWNT) within the pores has the potential of generating isolated very small diameter nanotubes that present interesting possibilities for phonon engineering and super-conductivity. We have explored 2 methods of preparing SWNTs within the pores of molecular sieve materials. The first involves the thermal decomposition of organometallic templates inside various zeolite hosts. For example, The extralarge pore zeolite, UTD-1 (below)is prepared using the organometallic complex bis(penta-methycyclopentadienyl)cobalt(III) ion. Decomposition of this template in the 1nm pores of UTD-1 provides both a catalyst (cobalt) and carbon source (ligands). Heating as-synthesized UTD-1 at 800^{o}C under argon, hydrogen or a vacuum results in the formation of SWNTs that are ~0.8nm in diameter. Characterization of the composites and SWNTs after zeolite dissolution will be presented including Raman, FT-IR, SEM, TEM, SQUID and thermal data. Results for other host zeolites including UTD-18, UTD-12 and ITQ-21 will be described.



The second method for encapsulation of SWNTs involves the synthesis of the molecular sieve around the nanotubes. For example, the mesoporous molecular sieve DAM-1 is prepared using Vitamin E TPGS as a template. This organic molecule forms micelles which we have discovered will solubilize carbon nanotube bundles. The micelles containing the SWNTs are then heated with a silica source at low pH. The resulting DAM-1 (below) contains the template and SWNTs in the pores. Heating at 800^{o}C under argon or a vacuum leaves the encapsulated nanotubes within the pores. Details of the synthesis and characterization of these composites will be presented.