

# Energy Transformation by Interfacial Reactions

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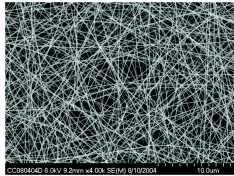


Nanomaterials have great potential to create next-generation materials for tribology, energy storage, composites, gas sensors, optoelectronics, catalyst support media, and biological interfaces.

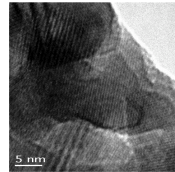
## Energy Control Sensors

Synthesis Methods

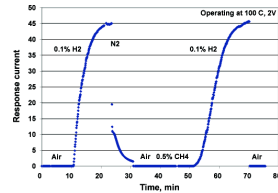
SEM Images of SnO<sub>2</sub> Nanorods (left) and Nanofiber (right)



HRTEM Images of Crystalline SnO<sub>2</sub> Nanorods (left) and Polycrystalline SnO<sub>2</sub> Nanofibers (right)

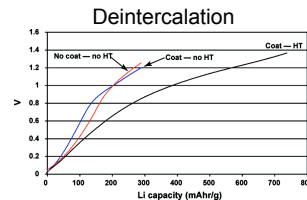
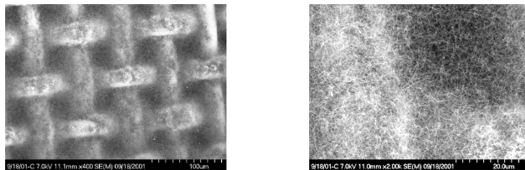


SnO<sub>2</sub> Nanorods With 0.5 nm Pd



## Energy Storage Li+ Batteries

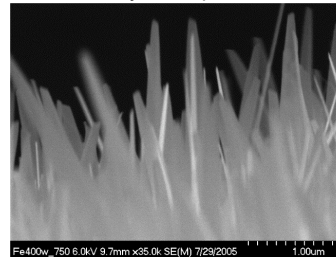
Scanning Electron Micrograph (SEM) Images of Carbon Nanotubes (CNTs) Synthesized Directly Upon Stainless Steel (SS) Mesh



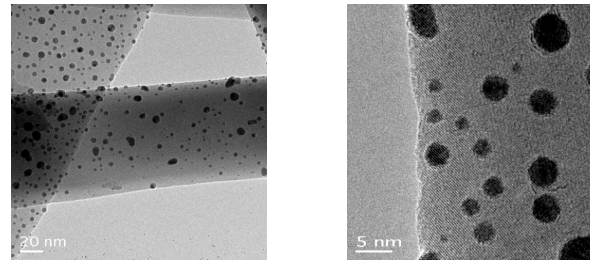
Modifications of the CNT surfaces increases the Li ion capacity beyond the theoretical limit of normal graphite.

## Energy Generation Catalysis

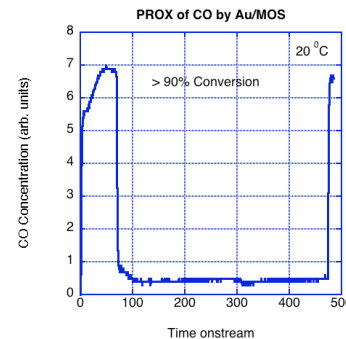
Fe<sub>2</sub>O<sub>3</sub> Nanoblades Supporting Au Catalyst Nanoparticles



SEM Images of Fe<sub>2</sub>O<sub>3</sub> Nanoblades



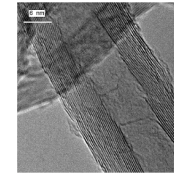
TEM Images Illustrating the Dispersion and Size Uniformity of Gold Nanoparticles



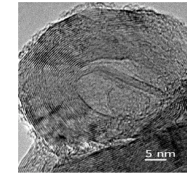
## Energy Efficiency Tribology

Nanomaterials Tested

Carbon Nanotubes and Nano-Onions and Fluorinated Derivatives of SWNTs and Nano-Onions

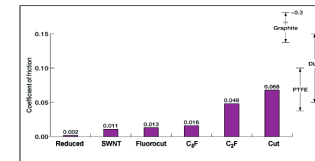


MWNT



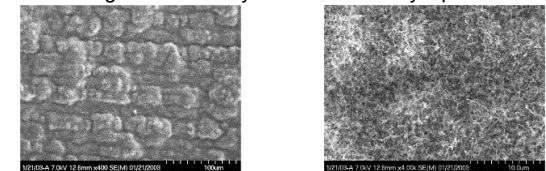
Carbon Nano-Onions

Coefficient of Friction for SWNTs in Contact With Sapphire in Air



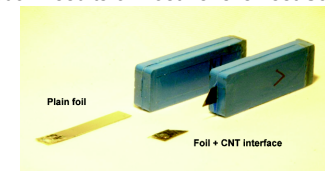
## Energy Conservation Composites

SEM Images of CNTs Synthesized Directly Upon SS Foil



CNTs are used to create a three-dimensional interface within a polymer composite. In the SEM images above, CNTs are synthesized upon the SS foil.

Visual Results of Post Tensile Test Samples



Comparative tensile strength tests of "fuzzy" foil show that the interfacial bond between the SS foil and host polymer matrix exceeds the tensile strength of the 0.007-in. foil.