MODEL FOR ASSESSING CARBON NANOPARTICLE INHALATION EXPOSURE RISK:
A Protocol for Combustion Emission Ultrafine Particulate Testing

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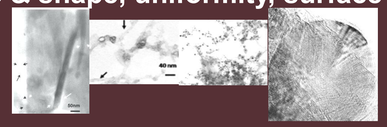
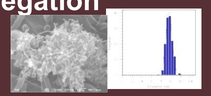
Nanoparticle Characterization

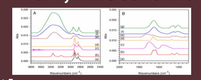
I. Morphology: nanoparticle size & shape, uniformity, surface defects
Microscopy: TEM, HRTEM
Field Emission SEM



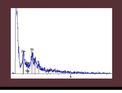
II. Nanoparticle Dispersion/Agglomeration/Aggregation
Microscopy, UV-Vis, dynamic light scattering



III. Surface Reactive groups & Charge: FT-IR, Zeta analysis

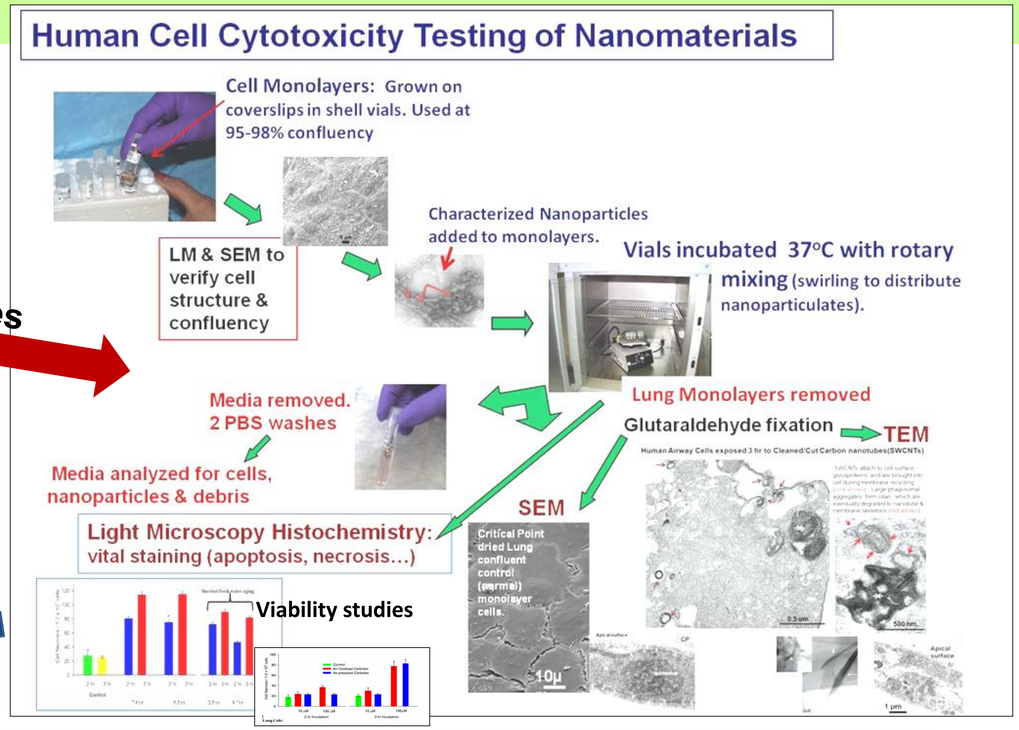


IV. Elemental Composition & Concentration:
X-ray microanalysis,
UV-Vis



Characterized Nanoparticles

Human Cell Cytotoxicity Testing of Nanomaterials



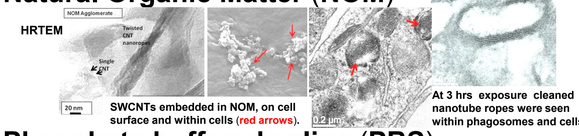
Tox Data

Correlate specific nanoparticle physicochemical characteristics with human cell exposure responses, to reveal specific nanoparticle characteristics associated with exposure risks via inhalation.

Simulated Aqueous Environmental Exposure Testing:

Nanoparticle (SWCNTs) characterization following aqueous exposure to:

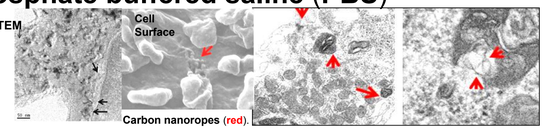
Natural Organic Matter (NOM)



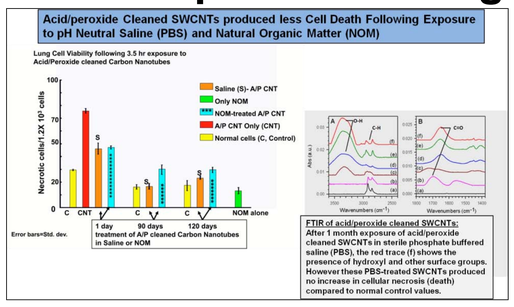
SWCNTs embedded in NOM, on cell surface and within cells (red arrows).

At 3 hrs exposure cleaned nanotube ropes were seen within phagosomes and cells.

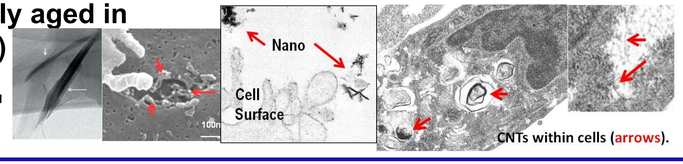
Phosphate buffered saline (PBS)



Carbon nanoropes (red).



Same SWCNTs aqueously aged in ultrapure water (~18MΩ.)



CNTs within cells (arrows).

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Testing Biomass Combustion Emission Ultrafine Particulates:

Portable Thermal Precipitator (Bang & Murr, 2006)

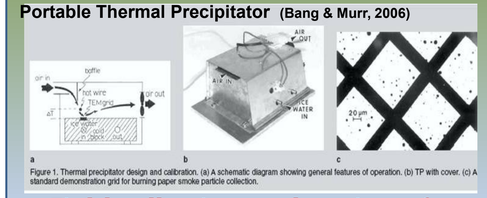

Figure 1. Thermal precipitator design and calibration. (a) A schematic diagram showing general features of operation. (b) TP with cover. (c) A standard demonstration grid for burning paper smoke particle collection.

Field collection and testing of UFPs will provide answers to:

- How similar are UFPs released into the environment to those released within the burner?
- Do UFPs collected in the environment show altered morphology? agglomeration/aggregation
- Do environmentally released UFPs show reduced surface reactive groups? Does this reduce risk?
- Following exposure to surface waters containing NOM, salt, etc… do UFPs exhibit different characteristics, or reveal altered interactions with lung airway cells reducing risk?

- **Collect / Characterize Ultrafine Particulates (UFPs) from within the biomass burner flue, as well as UFPs released at the burner exit flue. Compare UFPs released from these two sites** [morphology, surface reactive groups, elemental & amorphous composition, dispersion/aggregation, etc…].

- **Collect sufficient UFPs (µg) for rapid *in vitro* human airway cell testing, to determine viability, binding and intracellular UFP fate.**

- **Collect UFPs from different advanced technology burners to compare type, quantity and biological airway cell risk potential of emissions.**

- **Collect UFBs from the same advanced technology burner during combustion of different biomass fuels to evaluate physico-chemical and cytotoxicity characterization of each type of biomass-composition UFB emission.**