

Identification /characterization of wood combustion emission nanoparticles released from outdoor and indoor biomass (cord wood) burners; and human lung cell interactions in vitro with these types of combustion nanoparticles

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ABSTRACT

Combustion emissions from wood burning boilers and stoves release various types of particulates into the environment. This presentation identifies and characterizes the smallest wood combustion nanoparticulates produced during different phases in the burn cycle of 5 different cord wood burners (two conventional outdoor wood burning boilers; two new advanced technology indoor wood boilers and an indoor wood stove). Combustion nanoparticulates were taken directly from the combustion gas stream, and characterized morphologically / compositionally using high resolution TEM, field emission SEM, x-ray microanalysis and selected area electron diffraction (SAED). Following characterization, harvested nanoparticles and nanoparticle-agglomerates were tested in vitro at low and high doses with human lung bronchiolar epithelial cells to assess cell viability (vital staining), and intracellular cellular responses over time. In each of the biomass burners studied we found a new type of nanoparticle ((nano-salt crystalline spherules) as small as 1.2-1.4 nm to ~7.0 nm diameter, as well as turbostratic graphene spherules (~20 nm diam.) and a new type of hollow graphitic spherule (~30-36nm diam.). The elemental composition of the smallest nanoparticles varied with the biomass burner studied, even though the same oak cord wood was used under controlled conditions for each trial. The uptake of the smallest nano-salt crystalline nanoparticles occurred directly through the mucin covered plasma membrane without endocytosis. Graphene, and graphitic, spherule chains were observed entering the cells and localizing within the nuclei and nucleoli of viable lung cells.

BIOGRAPHY

Dr. Panessa-Warren holds undergraduate and graduate degrees (B.A.,MS,Ph.D) from New York University with training in botany, field ecology, mammalian cell biology, anatomy, and electron microscopy/ x-ray microanalysis. After graduating she was a NIH post-doctoral fellow at the NYU Medical School, Dept. of Biophysics and Physiology and joined the faculty at Stony Brook University Medical School in 1977. She was also a faculty member at St.Vincent's Hospital Medical Center, NYC and taught human anatomy/physiology, pathophysiology, medical laboratory methods and medical physics. Dr. Panessa-Warren has received several prestigious IBM fellowships and

awards; for instance she was the first woman to receive the Burton Medal from the Microscopy Society of America in 1981.

Since 2000 Dr. Panessa-Warren has been at the Brookhaven National Laboratory, where she has worked extensively with developing new protocols to for electron microscopy to study nanoparticle structure/function and their interaction with biological systems. Recently, she has in collaboration with Dr. Tom Butcher's laboratory at BNL studied emission nanoparticles produced from wood combustion boilers and stoves, and investigated how these nanoparticles interact *in vitro* with human lung epithelial cells.