and 101 mg (toluene)/g (BP) for non-cleaned, acetone cleaned, methanol cleaned AD BPs, and HiPco BP, respectively.

Conclusions: HiPco BP had the highest SA and toluene adsorption capacity and among AD BPs, methanol cleaned BP was the most adsorptive, indicating that the cleaning process with methanol was the most desirable to fabricate AD BPs. Overall, toluene adsorption capacity was proportional to the SA. The fabricated BPs will be further annealed to increase SA and investigated on desorption efficiency using photothermal desorption technique which can shorten the current analytical procedure and consequently, exposure assessment time.

CS-108-03

Investigation of Airborne Particulate Matter on the International Space Station (ISS) Using a Thermophoretic Sampler

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Situation/Problem: It is important to maintain excellent air quality and to minimize deposition of particulates on surfaces in the International Space Station (ISS) environment. A significant challenge arises as there is a fixed volume of air on ISS and there is no dilution, venting or gravitation settling of debris or particulates. As a result, the potential release of particulates and other contaminants from on board activities needs to be well understood to adequately recognize, evaluate and control any potential emissions that may occur during operation. NASA has down-selected a thermophoretic sampler (TPS) as a means to sample airborne particulates on the ISS.

Resolution: Studies are underway to adapt the TPS for outer space applications for a sampling experiment on the ISS. One of the studies performed demonstrating the use of the TPS has been the preliminary testing of particulate releases from the use of 3D printers on Earth. Initial test measurements have been obtained using direct-reading instrumentation to evaluate both the number abundance and size distributions of particulates associated with a variety of different printing activities. Sampling of particulates has also been performed in order to characterize the emissions using electron microscopy techniques. The use of a miniaturized thermophoretic sampler (TPS) was implemented to sample the air because, in part, it is easy to use and particles are deposited directly onto a TEM grid for examination. This use of the TPS direct deposition technique is also preferred to minimize the likelihood that particulates could be disaggregated or dissolved in the sample preparation stages involved with filter based techniques.

Results: The results from the use of the direct-reading instruments often indicate the presence of airborne particulates from study related activities with particles detected being in the nano-size (< 100 nm) range. In the case of 3D printing testing, early results indicate that there are differences in particle emissions from different printing scenarios. In this instance and during other tests performed, the use of the TPS has been demonstrated to be a useful technique in obtaining samples suitable for electron microscopy examination in order to characterize particulates.

Lessons learned: Additional study and planning is desired in order to understand the air quality implications involved with human and other operational activities performed in the ISS environment. The TPS has already been chosen for a flight technology demonstration. One of the challenges that has been uncovered is the need to modify the TPS design so that heat will be appropriately dissipated in a low gravity environment. A low gravity version is being fabricated and space flight hardware acceptance testing is underway. A customized version of the TPS is scheduled to be deployed on the ISS in 2016. An update on the engineering solutions and preliminary testing results from use of the TPS will be presented.

SR-108-04

A Standardized Approach for the Generation and Characterization of Aerosols Released from Composite Nanomaterials in Industrial Scenarios

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Objective: Develop and test a standardized method for generation and characterization of particles released from composite nanomaterials undergoing mechanical stress.

Methods: An adaptable system was developed to accommodate life-cycle events (e.g., sanding, sawing) for test materials and consumer products. The system consisted of a sand-blasting cabinet with HEPA-filtered air intakes. An electrical motor was exteriorized and connected to a pulley through a v-belt. Inside the cabinet, the pulley was connected to a shaft that could accommodate various types of equipment such as a belt sander, a saw blade or a drill chuck. A material feeder with constant force was constructed. The system was tested with a belt sander by sanding: 1) glass fiber/epoxy resin, 2) glass fiber/epoxy resin containing post-coated multi-walled carbon nanotubes (MWCNTs), 3) epoxy resin, 4) epoxy resin containing MWCNTs, 5) epoxy resin containing glass-fiber-infused MWCNTs, 6) epoxy resin containing carbon black, and 7) epoxy resin containing carbon black and MWCNTs. Total number concentrations, respirable mass concentrations, and particle size number/mass distributions of the emitted particles were measured using a scanning mobility particle sizer, an optical particle counter and a condensation particle counter. Additionally, samples for electron microscopy analysis were collected with a thermophoretic sampler and filter samples. Measurements were taken in triplicate for each material with coarse (150 grit) and fine (320 grit) sandpaper.

Results: The highest number concentrations (arithmetic mean = 2670 particle/cm^3) were produced with coarse sandpaper, epoxy resin containing carbon black and MWCNTs. The lowest number concentrations (arithmetic mean = 600 particles/cm^3) were produced with fine sandpaper, epoxy resin containing MWCNTs. The highest respirable mass concentrations (arithmetic mean = 1.01 mg/m^3) were measured for fine sandpaper, epoxy resin containing MWCNTs and lowest (0.2 mg/m^3) for coarse sandpaper, glass fiber/epoxy resin. Airborne particles were primarily micrometer sized with CNT protrusions.

Conclusions: The system provides a replicable and adaptable method for characterizing the particles released during an industrial use scenario. In this example, the number concentration, mass concentration and number size distribution of airborne particles depended on the characteristics of the material being sanded and the sandpaper grit.

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