NASA SBIR 2008 Phase I Solicitation

X2.02 Spacecraft Cabin Atmospheric Resource Management and Particulate Matter Removal

Lead Center: MSFC

Participating Center(s): ARC, GRC, JSC, KSC, MSFC

Particulate Matter Removal and Disposal

Particulate matter suspended in the habitable cabin atmosphere is a challenge for all phases of exploration missions. Removing and disposing of particulate matter originating from sources internal to the habitable cabin and from surface dust intrusion is of interest. Process technologies and equipment that efficiently remove the range of particulate matter sizes and morphologies encountered in a crewed spacecraft cabin from the atmosphere and surfaces are sought. Candidate technology solutions should provide high efficiency and long-lived removal capacity. Successful process technologies must be tolerant of the abrasive properties of lunar surface dust. Performance should be demonstrated with appropriate lunar dust analogs or simulants. Process technologies sought must be highly efficient and promote safe disposal of accumulated particulate matter. Areas of emphasis include:

- Removal and Disposal of Fine Particulate Matter Suspended in a Cabin Atmosphere: It is hypothesized that fine particulate matter introduced into the cabin will be detrimental to crew health. Filtration technologies are sought that will limit the levels of lunar dust contaminants of less than 10 micron size in the cabin atmosphere below 0.05 mg/m^3 while providing significantly improved capture efficiency with minimal pressure drop. These may include but are not limited to mechanical filtration, inertial separation and impingement, and electrostatic and/or electrically enhanced separation solid-gas processes that are light-weight, low power and operate at reduced atmospheric pressures. Process technologies that offer both improved efficiency and are suitable for in situ regeneration as described below are preferred. Novel techniques and materials are of interest.

- Regenerative Processes and Filters: Regenerable solid-gas separations techniques and process technologies are sought that effectively handle a broad size range from >100 microns in aerodynamic diameter to
- Vacuum Cleaner for Planetary Surface Vehicles and Habitats: Portable crew-operated devices for removing particulate matter from a wide range of surfaces (polymer, metallic, and fabric), operating at cabin atmospheric pressures ranging from 8 to 15 psia, and minimizing electrical power and acoustic noise generation are of interest. Successful devices may employ several of the above mentioned processes or filtration systems to remove a wide range of particulate matter sizes up to 2 mm in aerodynamic diameter without contaminating the air with ultrafine particulates. The ability for the portable device to be operated as a supplemental, portable cabin air filtration unit is a plus.

Atmospheric Resource Management

Atmospheric resource management encompasses process technologies and equipment to supply, store, and condition atmospheric gases; provide gaseous oxygen at pressures at or above 3,600 psia; and achieve mass closure by recycling resources and using in situ resources. Areas of emphasis include:

- Carbon Dioxide Reduction for Recovery of Oxygen: Process technologies for reducing carbon dioxide to a carbon product via high single-pass reaction efficiency with a product yield >90% are of interest. Successful process technologies and/or process technology unit operations combinations must demonstrate efficient power use and address safety issues associated with traditional reduction processes.
- High Pressure Oxygen Gas Supply: Process technologies leading to an on-demand, in-flight renewable source of oxygen at or above 3,600-psia are of interest. Process technologies employed for achieving these needs may include mechanical compressors, temperature or pressure-swing adsorption compressors, high pressure electrolytic oxygen production or other novel means.