NASA SBIR 2004 Phase I Solicitation

S5.01 Detection and Reduction of Biological Contamination on Flight Hardware and in Return Sample Handling

Lead Center: JPL

Participating Center(s): ARC

As solar system exploration continues, NASA remains committed to the implementation of its planetary protection policy and regulations. Missions designed to return the first extraterrestrial samples since the Apollo moon landings are currently in space—the Stardust and Genesis spacecraft will return cometary and solar wind particles to Earth within this decade. A mission to return samples from Mars is being planned for the next decade. Other missions will seek evidence of life through in situ investigations far from Earth. One of the great challenges, therefore, is to develop or find the technologies or system approaches that will make compliance with planetary protection policy routine and affordable. Planetary protection is directed to 1) the control of terrestrial microbial contamination associated with robotic space vehicles intended to land, orbit, flyby, or otherwise be in the vicinity of extraterrestrial solar system bodies; and 2) the control of contamination of the Earth by extraterrestrial solar system material collected and returned by such missions. The implementation of these requirements will ensure that biological safeguards to maintain extraterrestrial bodies as biological preserves for scientific investigations are being followed in NASA's space program. To fulfill its commitment, NASA seeks technologies and system approaches that will support compliance with planetary protection requirements.

Examples of such technologies include:

- Techniques for cleaning of organics to the nanogram per square centimeter level on complex surfaces (nondestructively and without residues) and validation of cleanliness at this level or better
- Nonabrasive cleaning techniques for narrow aperture occluded areas on spacecraft
- Techniques for in situ (i.e., at the exploration site) cleaning and sterilization to prevent cross-contamination between planetary surface samples
- A device or methodology for controlled measurement of microbial reduction at temperatures from 200–300°C to enable generation of microbial lethality curves.

Examples of systems approaches include:
• Containerization and encapsulation of samples to be returned to Earth, including innovative mechanisms for isolation, sealing, and leak detection

• System design concepts to enable facile and rapid use of cleaning and sterilization technologies during flight hardware assembly

• System design concepts to maintain the integrity of cleaned and sterilized complex flight systems and/or subsystems

• System concepts that would facilitate spacecraft sterilization at the system level just before launch or in flight

Research should be conducted to demonstrate technical feasibility during Phase I and show a path toward a Phase II hardware and software demonstration, and that will, when possible, deliver a demonstration unit or software package for JPL testing before the completion of the Phase II contract.