



NASA SBIR 2016 Phase I Solicitation

H3.01 Environmental Monitoring

Lead Center: JPL

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

Environmental Monitoring is comprised of the following four monitoring disciplines: Air, Water, Microbial and acoustics. ISS has employed a wide variety of analytical instruments to deal with critical items. These functional needs are required to address identified risks to crew health during Exploration-class missions. The current approach onboard ISS, if any, will serve as the logical starting point to meeting the functional needs. However, the following limitations were found common to all the current approaches on-board ISS for any missions beyond low-Earth orbit (LEO): reliance on return sample and ground analysis, require too much crew time, constraints on size, mass, and power, lack of portability, and insufficient calibration life.

Hence a concerted effort is underway to address these gaps, determine the most promising solutions, and mature those solutions to ground and flight technology demonstrations. Technologies that show improvements in miniaturization, reliability, life-time, self-calibration, and reduction of expendables are of interest.

Methods for collection and concentration for microbial surface monitoring

NASA continues to invest in the near- and mid-term development of highly-desirable systems and technologies that provide innovative ways to monitor microbial burden and enable to meet required cleanliness level of the closed habitat. To date, systematic microbial monitoring of ISS is carried out for water and not for environmental surfaces or air. The sample collection and subsequent processing for either culturing or molecular methods require sample concentration. Presently, swabs are used to collect 25 cm² area before processing and often times this outdated technique is fraught with decreased sensitivity in removing biological materials from the surface. NASA is interested in an integrated sample collection/concentration/extraction system that could feed samples to conventional or molecular microbial monitoring techniques. Furthermore, integration of these steps and a sample delivery to the molecular instruments (such as PCR) as a single module is solicited. Required technology characteristics include a 2 year shelf-life and functionality in microgravity and low pressure environment (~8 psi). The proposed integrated sample collection/concentration/extraction delivery system for molecular microbial monitoring detection should be capable of collecting and concentrating all kinds of microorganisms including “problematic” microbial species on-board ISS (ISS MORD: SSP 50260; (<http://emits.sso.esa.int/emits-doc/ESTEC/AO6216-SoW-RD9.pdf>)).

Ethylene analyzer

Ethylene gas is a natural metabolite in plants and acts as a plant hormone. In closed settings, such as plant (food) production chambers, ethylene can build up to deleterious levels for the plants. NASA needs innovative concepts for monitoring ethylene on a real time or near real time basis. Detection limits should ideally be near 25 ppb to insure effective management of plant growth systems, both for fundamental space research and for using plants in bioregenerative life support applications.

Calcium, conductivity and pH monitors for urine and wastewater

A rugged calcium sensor is needed to optimize the percentage of the recovery from brine. The calcium sensor would allow engineers to process a urine batch by knowing precisely the actual calcium concentration, enabling the urine processor to approach the solubility limit of calcium species. The calcium sensor would need to be able to measure calcium at levels of 50-400 mg/L in urine that has been pretreated to a pH of 0.5-3.0. The sensor should be rugged and not require frequent calibration or replacement and should be accurate to within 10%. Rugged conductivity and pH sensors that monitor the conductivity and pH in the brine loop would allow brine to be processed more thoroughly to recover more water. As the brine becomes more concentrated during urine processing, the measurement of conductivity and pH would allow the processor to recover water just to the point of solids precipitation. The conductivity sensor should be able to measure conductivity from 10-250 mS/cm in a urine brine that has a pH of 0.5-5.0. Likewise the pH sensor should be able to measure pH from 0.5-5.0 in a urine brine that has the conductivity of 10-250 mS/cm. The sensor should not require frequent calibration or replacement and be accurate to within 15%.