A Miniaturized Sensor for Microbial Monitoring of Spacecraft Water Environment

Topic: X2.03, PI: Yi Wang, Project No. NNX10CE27P

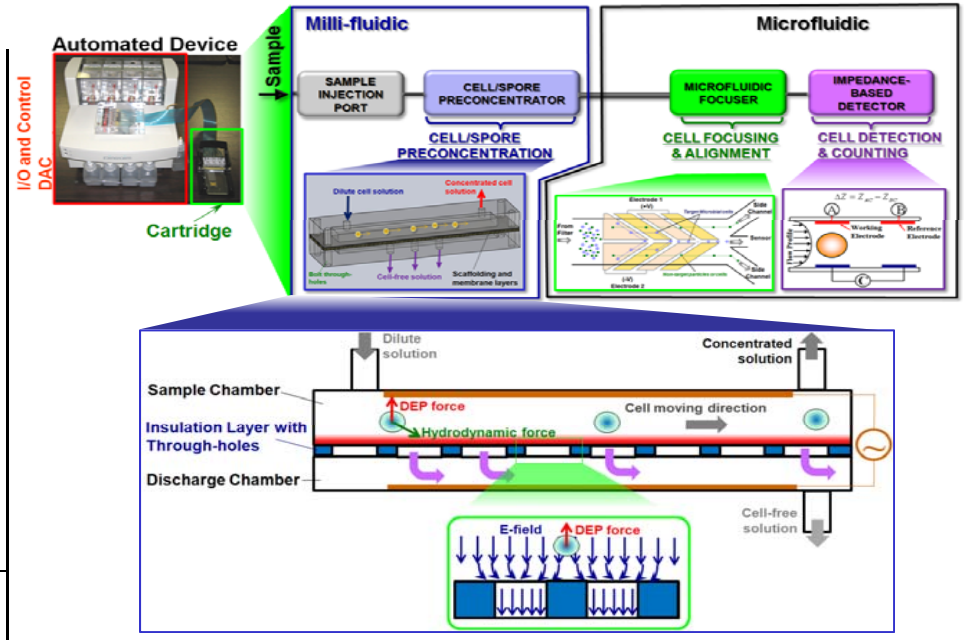
Identification and Significance of Innovation

- Real-time monitoring of microbes in spacecraft environment is critical to ensure crew health and proper functioning and control of the life support system
- Conventional microbial assays are time-consuming, labor-intensive and difficult to deploy in the spacecraft environment; Rapid immunological and nucleic acid based approaches require consumables
- Proposed effort is to develop a novel miniaturized, automated, label-free sensor to automate sample preparation and detection for microbial monitoring in spacecraft water environment
- Phase 2 end-product offers unique benefits for microbial monitoring of spacecraft water environment, including: (1) long shelf-life, (2) low logistical burden and reusability; (3) fast label-free analysis; and (4) fully automated and in-line operation, among others
- TRL: Begin at TRL-2 and end at TRL-5

Phase 2 Technical Objectives and Work Plan

Develop a novel miniaturized, automated, label-free sensor for microbial monitoring in spacecraft water environment

- Optimally design the major sensor components, viz., DEP-preconcentrator, microfluidic focuser, and impedance-based sensor
- Refinement of fabrication procedure, and material and experimental protocols
- Extensive characterization and validation of components using 'Fab5' bacteria and other microbes of NASA interest.
- System design and integration of critical components into a single miniaturized cartridge along with COTS components and peripherals for automated operations
- Prototype demonstration for microbial detection using composite microbial samples at multiple concentration levels.
- Technology transfer and commercialization efforts will commence during Year 2 and continue in the out years.



Dielectrophoresis-driven Cross-Flow Preconcentrator

NASA Applications

- Real-time microbial monitoring of water in spacecraft, shuttle, and ISS during long-term space mission to minimize microbial exposure/infection hazard to crew health
- Monitoring of microbes in water to evaluate the performance of the life support system

Non-NASA Applications

- Water monitoring in industrial facilities (wastewater treatment)
- Water quality control in public sectors (hospitals, drinking and recreational waters)
- Pre-clinical and clinical point-of-care diagnostics (pathogen detection in body fluids)

Firm Contacts

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