

A Miniaturized Sensor for Microbial Monitoring of Spacecraft Water Environment
Topic: X2.03 Spacecraft Environmental Monitoring and Control, PI: Yi Wang, Ph.D.

Identification and Significance of Innovation

- Real-time monitoring of microbes (bacteria, coliform, and fungi etc.) in spacecraft environment is critical to ensure the crew health and the 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 immunassay-based approaches inherently have limitations of short shelf-life
- Need leveraged and synergized harnessing of technological advancements in milli-fluidics, microfluidics, electrokinetics, cell biology, and lab-on-chip systems to engineer a solution

Technical Objectives

- Develop a miniaturized sensor device for accurate microbial monitoring with automated sample preconcentration, cell/spore differentiation and selection, and impedance spectroscopy flow cytometry
- Fully automated sample processing and analysis
 - Real-time analysis (< 30 minutes, non-culture approach)
 - High processing throughput (1-100 ml)
 - Negligible uses of consumables and low cost
 - High sensitivity and accuracy
 - Simple, robust, and compact

Work Plan

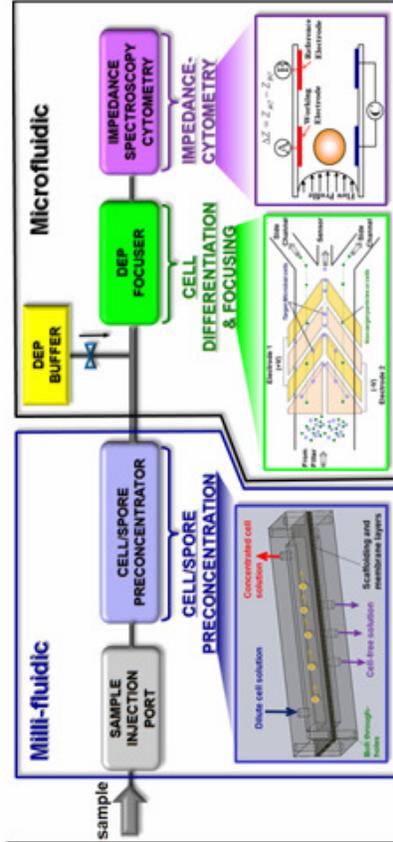
Phase I

- High-fidelity design of microfluidic components
- Microfabrication of microfluidic components
- Experimental characterization and demonstration of proof-of-concept

Phase II

- Parametric analysis and design optimization
- Refinement of fabrication and characterization protocols
- Development of the integrated cartridge and peripheral instrumentations to form a self-contained, automated device
- Technology demonstration in terrestrial and space water environment

Schematic



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

Commercial Applications

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

Firm Contacts

Performer: CFD Research Corporation, Huntsville, AL
 PI: Dr. Yi Wang, Tel: 256-726-4971; E-mail: yxw@cfdrcc.com