Microfluidic Icy-World Chemistry Analyzer (MICA): Plans and Progress

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The Microfluidic Icy-World Chemistry Analyzer (MICA) is a sample-processor-integrated, microfluidic implementation of the Wet Chemistry Laboratory (WCL), an array of electrochemical sensors that delivered key science findings on the Phoenix Mars mission. MICA's development and implementation leverage Ames' proven spaceflight microfluidics experience; the Sample Processor for Life on Icy worlds (SPLIce) COLDTech project led by Ames with participation by our JPL, Tufts, GSFC, APL, and University of Alberta partners; and the original WCL implementation, plus recent mWCL (Microfluidic WCL) COLDTech project and associated heritage and expertise from Tufts, JPL, and Ames.

MICA's primary goal is to mature an innovative, high-impact instrument for Europa exploration, in particular to characterize multiple chemical species potentially indicative of the habitability of Europa's subsurface ocean. Accordingly, MICA addresses multiple goals and objectives from the Europa Lander Science Definition Team's Science Traceability Matrix: detecting and characterizing inorganic indicators of past or present life; determining the provenance of sampled material; characterizing the non-ice composition of Europa's near-surface material to measure chemical dis-equilibria and other environmental factors essential for life. MICA includes an array of cation and anion ion-selective electrodes; sensors to measure pH, conductivity and redox potential; and cyclic voltammetry plus chronopotentiometry to quantify electroactive species. Targeting a 1-mL sample volume, MICA integrates all reagents and implements microfluidic processes to condition and calibrate its electrochemical sensors.

We will report on the design, construction, integration, and testing to date of a MICA breadboard meeting requirements flowing from the above objectives; at project end, it will be at TRL 5, with key subsystems at TRL 6; it will meet accommodation constraints defined by ICEE 2 documentation. The MICA project team works closely with the JPL Europa Lander team and other ICEE2 selectees to determine how to share sample-processing capabilities across several of the principal instruments to reduce resource demands and risk without adverse impacts on performance.