

Characterization of Ocean Residues and Life Signatures (CORALS)

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The Characterization of Ocean Residues and Life Signatures (CORALS) investigation, funded through the NASA ROSES ICEE 2 Program, promises to redefine our understanding of astrobiology targets and other planetary environments. The CORALS instrument (8.0 kg, 41 W) centers on three key subsystems:

- i. an OrbitrapTM mass analyzer capable of ultrahigh mass resolution ($m/\Delta m \geq 100,000$, FWHM at m/z 100), ppm-level mass accuracy, and an adjustable mass range that can detect atomic ions at low masses (e.g., ^{23}Na) and prospective macromolecular organics beyond 2000 Da;
- ii. a high-power pulsed laser system that generates up to 450 μJ of 266 nm radiation, and incorporates a MEMS steering mirror to enable active beam scanning across the sample surface (supporting the derivation of 2D chemical images); and,
- iii. a series of ion lenses that serve to accelerate ions created at the sample surface (either grounded or at voltage), and focus the ion beam into the Orbitrap analyzer.

Together, these hardware elements define a highly versatile laser desorption/ablation mass spectrometer that can access the organic content (e.g., potential biosignatures) and inorganic composition (e.g., mineralogy) of solid samples down to fmol/mm^2 concentrations, measure isotopic abundances with $\%$ -level precision, and map chemically-distinct micron-scale morphological features.

Here, we describe progress in the fabrication, assembly, and test of a high-fidelity engineering unit that meets the form/fit/function of a flight model adapted for operations on the Europa surface, and designed in compliance with the mechanical, electrical, and thermal interfaces of the evolving lander design (as coordinated with the Europa Pre-Project Team). Data collected on a pathfinder instrument pioneered by a consortium of French laboratories, as well as a progressive prototype built collaboratively by UMD and NASA GSFC, provide a reference point by which to compare the performance of the CORALS ETU.