

Adapting the Compact Integrated Raman Spectrometer (CIRS) for the Europa Lander Mission Concept

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The Compact Integrated Raman Spectrometer (CIRS) as configured for the Europa Lander Mission Concept is designed to analyze samples in their frozen, melted, and desiccated states. The instrument is equipped with an integrated sample handling system that would accept 3 sample cups each filled with approximately 1cm³ of icy regolith acquired nominally 10 cm below the surface. The bottom of each sample cup contains a transparent window through which Raman spectroscopy would be performed using 532nm (green) continuous-wave laser excitation. While frozen the samples are held at a temperature of 150K, and would be scanned for ice veins which may contain concentrated materials expelled from crystalline domains during freezing. Additionally, Raman spectra collected of putative salt hydrates entrained within the frozen sample would determine if they are in a crystalline or amorphous state and may inform as to the emplacement mechanism of the ice. The samples would then be melted under pressure to quantitatively measure the concentration of dissolved ions using chemometric methods. Finally, the liquid portion of the sample would be evaporated in a controlled manner in order to concentrate the sample's nonvolatile constituents directly onto the sample cup's clear window for Raman analysis using point counting. The optical train of the CIRS instrument is being designed to be TRL 6 and to survive at radiation levels expected within the Europa Lander's vault. Critical radiation hardened components in the instrument include a frequency-doubled laser, cerium-doped optical glasses, and focal plane arrays.