WHY RAMAN AND LIBS FOR EXPLORING ICY MOONS?

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ICY MOONS

- The most compelling locations to seek an answer to the question of whether life exists beyond our own planet.
- Analysis of the composition of the icy crust is critical for determining the availability of nutrients for life that may be present in subsurface liquid reservoirs.
- “The surface ice is providing us a window into that potentially habitable ocean below,” [1]

RAMAN-LIBS ADVANTAGE

- Laser Raman and laser-induced breakdown spectroscopy (LIBS) are uniquely suited tools for detailed mineralogy and geochemistry investigations on planetary bodies.
- LIBS can reveal the relative concentration of major (and often trace) elements present in a bulk sample.
- Raman yields information on the individual mineral species and their chemical and structural nature.
- Thus, combining the data from both tools enables definitive mineral phase identification with precise chemical characterization of most major and minor and some trace mineral species.
- A combined instrument can provide a rapid mineralogical/chemical evaluation of the target

CASE STUDY: LIBS AND RAMAN SPECTRA OF MIXTURES OF ICE WITH SALTS AND ORGANICS

LIBS spectra of ionized H₂O and frozen supersaturated solutions of KCl, MgSO₄, and NaSO₄ in water. Spectra recorded at -25 °C and 1020 mbar of air with instrumentation described in [2]. The emission lines related to H and O were monitored at 656.3 and 777.4 nm, respectively. K, Mg, and Na are monitored at 766.6, 285.6, and 568.8 nm, respectively.

Raman spectra of several mixtures, including a mixture of Ca, Mg, Na, and K-sulfates and H₂O ice (sulfates/H₂O). The spectra were obtained at -50 °C. Molecular vibrational modes have been identified, which in turn inform about potential associated ions, thus complementing LIBS.

CONCLUSIONS

- Elemental and molecular features of water ice mixed with salts and organics, relevant to icy planetary bodies, can be analyzed using laser Raman and LIBS.
- We are developing quantitative methods for the determination of species’ abundances in mixtures.


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