SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 2 (3B)

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A COMPACT SPATIAL HETERODYNE REMOTE RAMAN SPECTROMETER FOR MARS EXPLORATION

Abstract

The Spatial HEterodyne RAman instrument (SHERA) has been developed at the University of Surrey as a breadboard for a Mars exploration instrument. Raman spectroscopy is a chemical analysis method that requires no sample preparation and is sensitive to both organic and inorganic compounds. Spatial heterodyne spectroscopy (SHS) is a method of Fourier transform spectroscopy that enables high resolution in a compact package with no moving parts. SHS is a novel method to use in a Raman spectrometer that is ideally suited for spaceflight and surface exploration. The SHERA instrument operates with a 532nm excitation source and has a resolution of 0.25nm with a bandpass of 160nm. Results from the SHERA instrument agree well with control Raman spectra captured from a commercial laboratory Raman microscope. The SHERA breadboard instrument has been simulated using the ZEMAX ray tracing software package to validate the virtual design environment. This virtual design environment has enabled the design of a SHERA instrument that operates in the ultraviolet. UV Raman spectroscopy has several advantages: The Raman scattered signal scales inversely to the fourth power of wavelength so that reducing the excitation wavelength by half generates 16 times the signal. An excitation wavelength near 250nm allows Raman signal collection in a bandwidth that does not overlap with fluorescence from the sample material. The UV excitation has potential resonance bands with key life markers. The UV illumination incites fluorescence to provide is a secondary source of sample site information. The design of a flight-like SHERA instrument operating in the UV is presented for Raman spectroscopy investigations of the Martian surface.