

A Prototype Raman spectroscopic sensor for *in situ* mineral characterization on planetary surfaces

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Abstract

Raman spectroscopy has the potential to provide definitive identification and detailed characterization of the minerals that comprise rocks and soils on planetary surfaces. We have designed a probe head for Raman spectroscopy that is suitable for use on a spectrometer deployed by a rover or a lander on the surface of a planet such as Mars, the Moon, or an asteroid. The probe head is lightweight, low power, rugged, and simple. It is based on a tiny, distributed feedback diode laser and volume holographic components. A protective shell surrounds the probe head and serves as a mechanical stop for the mechanical arm of a planetary rover or lander during placement of the probe head onto the surface of a rock or soil. Pressing the shell against the rough surface of a target rock or soil also places the sampling objective of the probe head in rough focus, and the probe head is designed to be tolerant of focusing errors of ~5 mm. A breadboard version of the probe head gave spectra of high quality on clean crystals of diamond, sulfur, calcite, quartz, and olivine. The results are qualitatively comparable to those obtained using a conventional micro-Raman spectrometer on fine-grained travertine and on difficult specimens of basaltic lavas and impactites whose original mineralogy had been altered by reaction with water and air.