Geophysical Research Abstracts
Vol. 15, EGU2013-5983, 2013
EGU General Assembly 2013

Planetary Surface Exploration Using Time-Resolved Laser Spectroscopy on Rovers and Landers

Jordana Blacksberg (1), Erik Alerstam (1), Yuki Maruyama (1), Edoardo Charbon (2), and George Rossman (3)

(1) Jet Propulsion Laboratory, California Institute of Technology, United States (jordana.blacksberg@jpl.nasa.gov), (2) Circuits and Systems, Delft University of Technology, Delft, The Netherlands, (3) California Institute of Technology, Division of Geological and Planetary Sciences

Planetary surface exploration using laser spectroscopy has become increasingly relevant as these techniques become a reality on Mars surface missions. The ChemCam instrument onboard the Curiosity rover is currently using laser induced breakdown spectroscopy (LIBS) on a mast-mounted platform to measure elemental composition of target rocks. The RLS Raman Spectrometer is included on the payload for the ExoMars mission to be launched in 2018 and will identify minerals and organics on the Martian surface. We present a next-generation instrument that builds on these widely used techniques to provide a means for performing both Raman spectroscopy and LIBS in conjunction with microscopic imaging.

Microscopic Raman spectroscopy with a laser spot size smaller than the grains of interest can provide surface mapping of mineralogy while preserving morphology. A very small laser spot size ($\sim 1\ \mu$m) is often necessary to identify minor phases that are often of greater interest than the matrix phases. In addition to the difficulties that can be posed by fine-grained material, fluorescence interference from the very same material is often problematic. This is particularly true for many of the minerals of interest that form in environments of aqueous alteration and can be highly fluorescent. We use time-resolved laser spectroscopy to eliminate fluorescence interference that can often make it difficult or impossible to obtain Raman spectra. As an added benefit, we have found that with small changes in operating parameters we can include microscopic LIBS using the same hardware. This new technique relies on sub-ns, high rep-rate lasers with relatively low pulse energy and compact solid state detectors with sub-ns time resolution.

The detector technology that makes this instrument possible is a newly developed Single-Photon Avalanche Diode (SPAD) sensor array based on Complementary Metal-Oxide Semiconductor (CMOS) technology. The use of this solid state time-resolved detector offers a significant reduction in size, weight, power, and overall complexity - making time resolved detection feasible for planetary applications. We will discuss significant advances leading to the feasibility of a compact time-resolved spectrometer. We will present results on planetary analog minerals to demonstrate the instrument performance including fluorescence rejection and combined Raman-LIBS capability.