Geophysical Research Abstracts
Vol. 14, EGU2012-12730, 2012
EGU General Assembly 2012

Instrument for elemental composition studies of solids on planetary surfaces with sub-ppm detection sensitivity

M. Tulej, A. Riedo, S. Meyer, M. Iakovleva, M. Neuland, and P. Wurz
University Bern, Space Research and Planetary Sciences, Physics Institute, Bern, Switzerland (marek.tulej@space.unibe.ch)

Current space instruments prove to be successful for a global chemical mapping of the entire planetary body or to perform a local chemical analysis, helpful in determination of modal mineralogy. Nevertheless, the sensitivity and low spatial resolution of these spectroscopic instruments limit the chemical analysis to the most abundant elements with some exceptions (e.g., measurements of Th, K, and H elements by Gamma and neutron spectrometers). Furthermore, the spectroscopic analysis typically provides the chemical composition of 1 micrometer of the uppermost surface layers, which are frequently affected by space weathering effects, again, with the exception of Gamma/neutron investigation where the composition of up to 1 m thick subsurface can be measured. New and recently accepted space instruments, such as Laser Induced Breakdown (LIBS) and Laser Ablation/Ionisation Mass Spectrometers (LIMS) are thought to improve these chemical analysis providing more localised chemical sampling with higher sensitivity and accuracy.
We will demonstrate the performance of a highly miniaturised laser ablation time of flight mass spectrometer designed for space research for the elemental analysis of solid materials (Rohner et al., 2003). The instrument enables mass spectrometric analysis with sub-ppm detection limits and a typical mass resolution of $\sim$700, sufficient to detect all elements and their isotopes. The studies of NIST standards, minerals and meteoritic samples will be reviewed to emphasize its capability for quantitative analysis and chemical mapping of the inhomogeneous samples with a high spatial (vertical and lateral) resolution. LIMS measurements provide means for investigation of principal elements (metals, non-metals) and allow an analysis of trace elements distributed within a suite of soils and rocks. Thus, LIMS measurements will allow the identification of the mineralogical context of planetary surface and better understanding of the geologic/geochemical structure of a solar system body.

References

1) G.G. Managadze, P. Wurz, R. Z. Sagdeev, A. Chumikov, M. Tuley, M. Yakovleva, N. G. Managadze, and A. L Bondarenko, Study of the main geochemical characteristics of Phobos′ regolith using laser time of flight mass spectrometry, Sol. Sys. Res., 44, 376, 2011.
2) M. Tulej, M. Iakovleva, I. Leya, and P. Wurz, A miniature mass analyser for in situ elemental analysis of planetary material: performance studies , Anal. and Bioanal. Chem., 399, 2185, 2011.
3) U. Rohner, J. Whitby, and P. Wurz, A miniature laser ablation time-of-flight mass spectrometer for in situ planetary exploration, Meas. Sci. Technol., 14, 2164, 2003.