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Laser-based mass spectrometry for in situ chemical composition analysis of planetary surfaces

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Mass spectrometry is an important analytical technique in space research. The chemical composition of planetary surface material is a key scientific question on every space mission to a planet, moon or asteroid. Chemical composition measurements of rocky material on the surface are of great importance to understand the origin and evolution of the planetary body.[1]

A miniature laser ablation/ionisation reflectron- type time-of-flight mass spectrometer (instrument name LMS) was designed and built at the University of Bern for planetary research.[2] Despite its small size and light weight, the LMS instrument still maintains the same capabilities as large laboratory systems, which makes it suitable for its application on planetary space missions.[3-5] The high dynamic range of about eight orders of magnitude, high lateral (μm-level) and vertical (sub-nm level) resolution and high detection sensitivity for almost all elements (10 ppb, atomic fraction) make LMS a versatile instrument for various applications. LMS is a suitable instrument for in situ measurements of elemental and isotope composition with high precision and accuracy. Measurements of Pb- isotope abundances can be used for dating of planetary material. Measurements of bio-relevant elements allow searching for past or present life on a planetary surface. The high spatial resolution, both in lateral and vertical direction, is of considerable interest, e.g. for analysis of inhomogeneous, extraterrestrial samples as well as weathering processes of planetary material.

References

[1] P. Wurz, D. Abplanalp, M. Tulej, M. Iakovleva, V.A. Fernandes, A. Chumikov, and G. Managadze, “Mass Spectrometric Analysis in Planetary Science: Investigation of the Surface and the Atmosphere”, Sol. Sys. Res., 2012, 46, 408.

[2] U. Rohner, J.A. Whitby, P. Wurz, “A miniature laser ablation time of flight mass spectrometer for in situ planetary exploration” Meas. Sci. Tch., 2003, 14, 2159.

[3] M. Tulej, A. Riedo, M.B. Neuland, S. Meyer, P. Wurz, N. Thomas, V. Grimaudo, P. Moreno-García, P. Broekmann, A. Neubeck and M. Ivarsson, “CAMAM: A miniature laser ablation ionisation mass spectrometer and microscope-camera system for in situ investigation of the composition and morphology of extraterrestrial materials”, Geostand. Geoanal. Res., 2014, 38, 441.

[4] A. Riedo, M. Neuland, S. Meyer, M. Tulej and P. Wurz, “Coupling of LMS with a fs-laser ablation ion source: elemental and isotope composition measurements”, J. Anal. At. Spectrom., 2013, 28, 1256.

[5] A. Riedo, S. Meyer, B. Heredia, M. Neuland, A. Bieler, M. Tulej, I. Leya, M. Iakovleva, K. Mezger and P. Wurz, “Highly accurate isotope composition measurements by a miniature laser ablation mass spectrometer designed for in situ investigations on planetary surfaces”, Planet. Space Sci., 2013, 87, 1.