Implementations and Applications of Laser Ablation and Ionisation Mass Spectrometry for Earth and Space based Research

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In this contribution, we present two laser ablation and ionisation mass spectrometers (LIMS) developed at the University of Bern. The systems are used for the spatially resolved chemical analysis of solids, ranging from materials used in the semiconductor industry to geological samples that host old life forms. Both LIMS instruments use short laser pulses for the ablation and ionisation of the sample material, have a co-linear ablation geometry and are coupled to a time-of-flight mass analyser. However, the instruments differ in size and therefore have different performance and application characteristics. While one of the instruments is a compact space-prototype instrument developed for in-situ analyses of solids on other planetary bodies in our Solar System[1,2], the other instrument is a laboratory scale version intended for Earth-based chemical composition analysis[3,4].

We will present technical details of the setups, specifications, and applications of the two LIMS instruments. Both instruments are currently coupled to a femtosecond laser source. In the past nanosecond lasers operated at different wavelengths were used as well. We will therefore discuss the observed influence of the laser pulse width on measurement performance[1]. Furthermore, the impact of the laser wavelength on quantification based on measurements conducted with three different wavelengths ranging from IR to UV[5] will be discussed. Finally, we will show how the instruments' measurement capabilities were improved through small changes to the setup, including the installation of a double pulse system and a mass selective beam blanking device[6–8].

[1]A. Riedo et al., *Journal of Mass Spectrometry*, **2013**, 48, 1–15.
[2] U. Rohner, et al., *Measurement Science and Technology*, **2003**, 14, 2159–2164.
[3] C. P. de Koning, et al., *International Journal of Mass Spectrometry*, **2021**, 116662.
[4] R. Wiesendanger, et al., *Journal of Analytical Atomic Spectrometry*, **2019**, 34, 2061–2073.
[5] V. Grimaudo, et al., *Optics Express*, **2023**, 31, 17964-17986.
[6] M. Tulej, et al., *Journal of Analytical Atomic Spectrometry*, **2018**, 33, 1292–1303.
[7] A. Riedo, et al., *Rapid Communications in Mass Spectrometry*, **2021**,35,12.
[8] S. Gruchola, et al., *International Journal of Mass Spectrometry*, **2022**, 474, 116803.