# Laser ablation with funnel-focused mass spectrometry for improved resolution and analysis speed

Zuqiang Xu, Detlef Günther, Bodo Hattendorf

Laboratory of Inorganic Chemistry, ETH Zürich,
Vladimir-Prelog-Weg 1, CH-8093 Zürich, Switzerland
zuqixu@inorg.chem.ethz.ch

Spatially resolved element analysis has been used and applied widely in forensic science, geochemical analysis, biological imaging, etc. LA-ICPMS is of great interest in performing such analyses due to its high sensitivity, availability and robustness.[1] However, the substantial operating cost and extensive amount of argon gas as well as spectral inferences pose a limitation to this technique.[2, 3] Thus, a femtosecond laser ablation funnel-focused mass spectrometer (LAFUMA) system for high-speed, high sensitivity element imaging is currently developed.

LAFUMA comprises a positioning system, a femtosecond-laser source for desorption and ionization, custom-made convergent-divergent nozzle (CD nozzle) and ion funnel, ion optics connected to a time of flight mass spectrometer. The femtosecond laser allows for directly sampling and ionization while causing a minimal heat affected zone,[4, 5] thus preserving the structure of the adjacent sample regions. Compared to conventional laser ablation mass spectrometry methods, where ions are typically generated in high vacuum, the design of LAFUMA shall provide a higher sensitivity through ablation/ionization within a bath gas before a CD nozzle and an rf-only ion funnel transfer the ions into the MS. The previously described prototype instrument (Querci et al) has been further modified to now include a sample positioning system and an improved ion optics downstream the ion funnel. Initial experiments with the new setup were carried out to determine suitable operating conditions with respect to gas flow rates, pressure in the sample chamber.

[1] D. Günther, B. Hattendorf, *TrAC Trends in Analytical Chemistry* **2005**, 24, 255-265.
[2] A.J. Schwartz, Y. Cheung, J. Jevtic, V. Pikelja, A. Menon, S.J. Ray, G.M. Hieftje, *J. Anal. Atomic Spectrom.* **2016**, 31, 440-449.
[3] M. Schild, A. Gundlach-Graham, A. Menon, J. Jevtic, V. Pikelja, M. Tanner, B. Hattendorf, D. Günther, *Anal. Chem.* **2018**, 90, 13443-13450.
[4] L. Querci, V. Varentsov, D. Günther, B. Hattendorf, *Spectrochim. Acta B* **2018**, 146, 57-68.
[5] A. Riedo, M. Neuland, S. Meyer, M. Tulej, P. Wurz, *J. Anal. Atomic Spectrom.* **2013**, 28, 1256-1269.