Fs-LA-ICPMS for high throughput analysis

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Laser ablation coupled to ICPMS has become a powerful tool in quantitative analysis of solid samples and recently also in imaging and bioimaging applications due to the spatially resolved sampling resolution at µm-resolution and sensitivity [1,2]. However, the application to high throughput analysis and imaging of samples has been limited due to long transport time of laser-generated aerosols to ICP. Thus, a combination of femtosecond laser coupled with fast ablation cell [3] coupled to TOFMS will allow for fast and simultaneous detection of elements with high resolution and accuracy due to the reduced fractionation effects in materials science, geology and biological part for polymers, geological samples and tissues.

Initial experiments were performed using Pharos fs-laser system (wavelength: 257 nm, pulse duration: 190 fs) equipped with HeLex ablation cell [4] and Agilent 8900 ICPMS system. Four reference samples (BCR-2G, NIST SRMs 610, 612 and 614) were used with SRM 610 being the external calibration standard and ^{42}Ca as internal standard element to quantify for other 58 chosen isotopes. Quantification results were obtained and compared to investigate the relationships of quantification accuracies, sensitivities and LODs with different parameters including crater size, output energy and repetition rates.

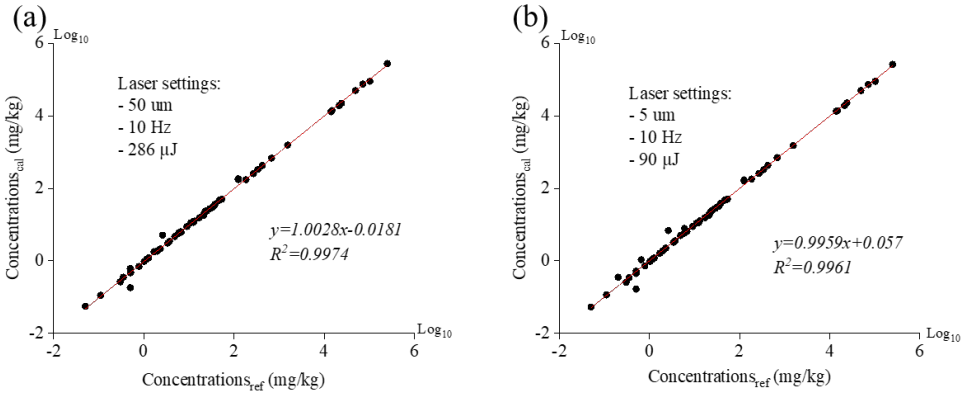

Figure Quantification results of BCR-2G in comparison with reference values with different parameters

Results showed that the quantified concentrations agreed with the certified values with deviations within 10% when using 50 µm and 5 µm in BCR-2G. Deviations occurred mostly for elements like As, Ag and Cd), whose mass fractions are close to the instrumental LODs. Investigation of laser output energy in relation to the spot size showed logarithmic relationship and the measured spot size in comparison with the system settings represented as linear correlation.

[1] A. Kindness, C. N. Sekaran and J. r. Feldmann, Clinical Chemistry, 2003, 49, 1916-1923.
[2] H. A. O. Wang, D. Grolimund, L. R. Van Loon, K. Barmettler, C. N. Borca, B. Aeschlimann and D. Günther, Analytical Chemistry, 2011, 83, 6259-6266.
[3] C. Neff, P. Becker and D. Günther, Journal of Analytical Atomic Spectrometry, 2022, 37, 677-683.
[4] W. Muller, M. Shelley, P. Miller and S. Broude, Journal of Analytical Atomic Spectrometry, 2009, 24, 209-214.