Femtosecond laser ablation: A recipe for success

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Femtosecond based laser ablation system are still quite rare in the analytical community since most of the app-lications in earth science can be tackled with nano-second laser systems. Advantages of femtosecond lasers ablation however, are mainly based on the different ablation process underlying the laser pulse interaction with matter and allowing for largely matrix independent calibration strategies. Therefore applications requiring high precision (<1 ‰) and matrix in-dependency are the primary field of femtosecond laser ablation and cover mainly the non-traditional stable isotope systems such as Li, B, Mg, Si, Fe, and Cu which require the use of the standard-sample bracketing procedure.Using faraday cups as the detection system a precision of ~ 0.1 ‰ (2SD) can be achieved routinely for the isotope systems of Mg, Si, Fe and Cu using MC-ICP-MS. During ion counting, however the obtainable precision is largely depending on counting statistical limitations resulting in a precision of <1permil (2SD) for the isotope systems of Li and B. With modifications to the interface region of the mass spectrometer those isotope systems can be determined at concentration levels of 3-5 ppm for B at the above precision using a 35 micron spot at a repetition rate of 10Hz. Under these conditions a sensitivity of ~70000 cps/ppm and ~250000 cps/ppm can be obtained on a Thermo Finnigan Neptune Plus for Li and U, respectively.

The goal for most applications is to use as little material as possible at high spatial resolution. In order to fulfil this the ablations rates/pulse have to be small which, however can only be achieved by controlling the energy density applied to the sample. Ablation threshold con-ditions are dependent on the wavelength and favour the use of deep UV light for ablation. Here we will discuss the concepts with respect to wavelength, energy density and focal position leading to a successful application of femtosecond laser ablation in chemistry.