Miniature LIMS for quantitative elemental imaging of heterogeneous materials with high spatial resolution

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Analytical techniques such as SIMS, LA-ICP-MS and GD-MS are state-of-the art measurement techniques today for high precision analysis of the chemical composition of solid materials with high spatial resolution, in research areas ranging from e.g., biological tissues to complex geological samples with micrometre-sized inclusions.

In this contribution we present the current measurement capabilities of our miniature LIMS system with figures of merit comparable to state-of-the-art analytical techniques, such as SIMS, LA-ICP-MS or GD-MS. The high detection sensitivity (10 ppb), high dynamic range of the instrument (~10^8) and the application of an femtosecond laser system (λ = 775 nm, τ = ~ 190 fs) for ablation and ionisation of sample material allow to conduct sensitive and quantitative measurements of the chemical composition of highly heterogeneous solids with high lateral (10–15 μm) and vertical resolution (sub-nanometre) [1]. Studies on the chemical composition of layered Cu materials will be presented to demonstrate the high vertical depth profiling capabilities at sub-nanometre level [1]. The new measurement protocol was applied subsequently for the detailed chemical analysis of complex sample structures, including e.g., fossils of micrometre dimensions embedded in aragonite matrix, heterogeneous rock sample or Pb-Bronze alloys [2, 3]. The high resolution depth profiling measurement protocol in combination with the capability to switch the LIMS system from ablation to desorption mode at desired vertical sample depth allow studies of the molecular composition at e.g., phase transitions, which is of considerable interest in various fields of research, including geology, chemistry and biology [4].

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