

## Compacted Nanoparticles for Quantification in LA-ICPMS

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Gray *et al.* did first studies of LA-ICPMS in 1985 [1]. Ever since, extensive research has been performed to overcome the problem of so-called “non-stoichiometric sampling” and/or analysis, the origins of which are commonly referred to as elemental fractionation (EF). EF mainly consists of laser-, transport- and ICP-induced effects, and often results in inaccurate analyses as pointed out in, *e.g.* references [2,3].

A major problem that has to be addressed is the lack of reference materials. Though the glass series of NIST SRM 61x have been the most commonly reference material used in LA-ICPMS, heterogeneities have been reported for some sample charges [4,5]. In addition, geological relevant elements such as Ti, Fe and Mg are present in very low concentrations only and thus not well suited for calibration. Elements such as Rh, Ru, Pd, Pt and Au (PGEs) are either absent or present in very low concentrations.

The production procedure of glass limits the implementation of these elements into the glass matrix at concentrations required for many applications. Therefore, alternative methods for the production of calibrants were studied concerning the implementation of PGEs into Silicates, Carbonates, and Iron-Sulfides, which are homogeneous at the spatial resolution commonly used in microbeam techniques.

Flame synthesis was used to reproduce the NIST 610 matrix at similar concentrations. Furthermore, PGEs and other elements were added to the matrix. The resulting powder consists of nanoparticles in the size range of 20-50 nm, which is well below the commonly crater diameters used in LA-ICPMS. The PGE concentration is for most of the elements around 500 mg/kg. Multiple analyses of these powders provide a RSD for PGEs in the order of 1-3 %. The difference between the pressed powder analysis and calcinated pellets shows indistinguishable results for most of the elements. The setup of production, preliminary results and first figures of merit will be discussed.

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## Evaporation behavior of forsterite (Mg<sub>2</sub>SiO<sub>4</sub>) in a H<sub>2</sub>O-H<sub>2</sub> gas

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Forsterite (Mg<sub>2</sub>SiO<sub>4</sub>) is one of the most abundant crystalline silicates in extraterrestrial materials and in circumstellar environments, and its evaporation behavior has been intensively studied in vacuum and in the presence of low-pressure hydrogen gas [*e.g.*, 1-4]. It has been known that the evaporation rate of forsterite is controlled by a thermodynamic driving force (*i.e.*, equilibrium vapor pressure), and the evaporation rate increases linearly with  $p\text{H}_2^{1/2}$  in the presence of hydrogen gas due to the increase of the equilibrium vapor pressure. The deviation of the actual evaporation rate from the ideal evaporation rate, which is given by an equilibrium vapor pressure and the kinetic theory of gases, is expressed as an evaporation coefficient (=Actual rate/Ideal rate) ranging from 0 to 1 (a measure of kinetic hindrance for evaporation). The evaporation coefficient is 0.1-0.01 for evaporation of forsterite in vacuum and in hydrogen gas depending on temperature and crystallographic orientation of the evaporating surface [*e.g.*, 1-4]. Besides the free-evaporation dominated regime [FED] (evaporation in vacuum) and the hydrogen-reaction dominated regime [HRD] (evaporation in hydrogen gas), Tsuchiyama *et al.* [5] proposed another evaporation regime called H<sub>2</sub>O/H<sub>2</sub> buffer-dominated regime [HBD] as a dominant evaporation regime for forsterite in protoplanetary disks at temperatures of <1400 K and under H<sub>2</sub>O-rich conditions. In the HBD regime, the equilibrium vapor pressure of forsterite is not controlled by  $p\text{H}_2^{1/2}$ , but by the H<sub>2</sub>O/H<sub>2</sub> ratio in the ambient gas. In spite of its potential importance, no experimental study has been done to investigate the evaporation kinetics in the HBD regime. We have performed evaporation experiments on forsterite at low pressures with controlled H<sub>2</sub>O/H<sub>2</sub> ratios, and have found that the evaporation rates are controlled by the H<sub>2</sub>O/H<sub>2</sub> ratio as proposed by [5] and that the evaporation coefficient is consistent with that in FED and HRD regimes.

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