Geophysical Research Abstracts
Vol. 20, EGU2018-15937, 2018
EGU General Assembly 2018

EGT – A sensitive time-of-flight mass spectrometer for multi-element isotope gas analysis

Andreas Riedo (1,2), Surya Rout (2), Reto Wiesendanger (2), Peter Wurz (2), and Ingo Leya (2)

(1) Leiden Observatory, Leiden University, Leiden, Netherlands (riedo@strw.leidenuniv.nl), (2) Physics Institute, University of Bern, Bern, Switzerland

High accurate analysis of the element isotope composition of gas samples, e.g. extracted from solids such as meteorites, terrestrial samples or simply from ambient air samples, is today typically accomplished by sophisticated sector field mass spectrometric instrumentation sometimes with multi-collector detection systems, often designed for specific species ranging from K to Xe isotopes, among other element isotopes. However, for the analysis of limited availability of sample material, e.g. rare meteoritic samples, sensitive and quantitative instrumentation with multi-element analysis capabilities are of interest to the science community, to tackle a scientific question from various sites. In this contribution we demonstrate the measurement performance and capabilities of a novel compact and sensitive mass spectrometer, on the basis of standard gases and preliminary measurements conducted on the meteorite Millbillillie.

The system discussed is a compact (overall dimensions of about 324 mm x Ø 114 mm) reflectron-type time-of-flight (RTOF) mass spectrometer (mass resolution m/Δm up to about 1'300, measured at Hg) that consists of pulsed electron-impact ion source. The gas inlet system is designed to analyse either gas samples collected and stored in e.g. a bottle or gas samples extracted from solids using CW laser system (fiber-coupled diode laser, < 75W CW, λ = 800 nm). In latter case, the laser pulses are focussed onto the sample surface to spot sizes of about 600 μm in diameter which allows the direct vaporisation of the solid sample material and releasing the trapped gases. The extracted gas passes subsequently a cleaning system that includes several cold stages before entering the compact mass analyser.

Measurements on residuals gas within the vacuum chamber (typical pressure at low level of 10-10 mbar) showed that the system has the measurement capability to detect species with a partial pressure down to about 4 x 10-16 mbar. Measurements conducted on standard gasses, such as Ar, Kr, Xe, demonstrate that the system can measure the respective isotopes at per mill level accuracy (rel. to terrestrial values). Latter allowed to analyse Ar isotopes extracted out of the meteorite Millbillillie; a 36Ar/38Ar ratio of about 1.6 was measured with is in agreement with literature values. During the contribution the design and working principles of the system as well the measurement will be discussed in detail.