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Miniature LIMS system designed for sensitive in situ measurements of organic deposits in materials on solar system objects

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In situ investigation of chemical composition is of considerable interest for application in planetary missions. The possibility of bio-relevant organic chemistry on the surfaces of comets and primitive asteroids is one of the most intriguing problems of the current astrobiology. Rock-water interface existed in early small solar body history, in addition to extensive mineralogical modifications of the surface could have initiated also a rich organic and bio-organic chemistry [1].
Current space instrumentation designed for molecular detection use thermal evaporation source combined with gas chromatography (GC) and mass spectrometry [2]. Hence, it is capable of collecting data of the volatile fraction of the investigated sample. Laser desorption mass spectrometry (LD-MS) is another method for molecule detection capable of vaporisation and ionisation of molecules present on a solid substrate surface, e.g. a rock. A miniature laser ablation ionisation reflectron-type time-of-flight mass analyser (LMS) developed by our group for in situ measurements of the elemental, isotopic composition can be used also for sensitive analyses of chemical compounds present on solid surfaces with high spatial resolution [3-6]. Comparing to laser ablation laser desorption analyses are conducted at laser irradiance reduced by approximately 10^3–10^4 times. In laser ablation mode, the LMS system offers high dynamic range of at least eight orders of magnitude and allows for the detection in the ppb range for metallic- and non-metallic elements. Instrument mass resolution $m/\Delta m$ is about 800 at the ^{56}Fe mass peak when the instrument is used in ablation mode. The mass resolution is increased to $m/\Delta m$ >1000 when desorption studies are conducted (at $\sim$600 m/q). We will demonstrate the instrument performance conducting molecular desorption studies of different species, e.g. organic, biotic and abiotic. Laser ablation/ionisation studies are conducted in parallel to complement the laser desorption analyses.

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