MOMA: THE MARS ORGANIC MOLECULE ANALYZER EXPERIMENT ON EXOMARS 2020

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Abstract

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In July 2020, the joint ESA/Roscosmos Exomars 2020 mission will send to Mars a Russian landing platform named 'Kazachok', carrying a European rover, named Rosalind Franklin. This rover will be equipped with a set of nine scientific instruments plus a drilling system. Three of these instruments are part of the Analytical Laboratory Drawer (ALD), for detailed analysis of the samples extracted from the Mars surface and subsurface. Those are an infrared spectrometer/imager, MicrOmega, a Raman spectrometer, RLS, and a chemical/molecular/chiral analyzer, MOMA (Mars Organic Molecule Analyzer).

MOMA is a unique miniaturized chemical laboratory entirely devoted to the search for organic molecules in the martian soil samples collected on the surface and in the subsurface, at depths down to 2 m.

MOMA will be able to perform detailed molecular and chiral analysis of the surface samples

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that have been potentially exposed to radiation and chemical transformations at the surface of Mars, as previously done by Viking and MSL missions. But, for the first time, it will also analyze samples from the subsurface at depth which may have been protected from the harsh surface conditions. Such capabilities will greatly increase the potential to detect organic materials of interest for astrobiology, such as organics of prebiotic interest or organic molecular signatures of past or even extent life.

To fulfill such ambitious scientific objectives, MOMA uses pyrolysis-chemical derivatization gas chromatography (Pyr/Der/GC) coupled to mass spectrometry (MS), and laser desorption ionization (LDI) coupled to MS.

It is composed of four complementary units:

i) a pulsed UV laser (l=266 nm) for performing Laser Desorption/Ionization (LDI) of molecules from the collected solid samples. Such soft ionization process produces intact parent ions from the sample, which can be directly analyzed by the MS

ii) a tapping station with a set of ovens for pyrolysis or chemical derivatization of the samples to allow the GC-MS analysis of polar or low volatility organics of astrobiological interest.

iii) a gas chromatograph (GC) able to separate the different constituents of the gas mixtures prepared in the ovens. The GC is equipped with 4 different columns to cover a large variety of organic compounds. One of the columns is devoted to chiral separation, in order to determine the possible enantiomeric excess of chiral organic compounds.

iv) an ion trap mass spectrometer (MS) to detect and identify the species produced by LDI, or, eluted from the GC

The MOMA Flight model instrument, after numerous tests, has been delivered for integration into the FM model of ALD. The MOMA team is now performing analytical tests and calibrations on the other models (i.e. the Engineering Test Unit and the Test Bed).
In this presentation we will give an overview of the instrument in the general frame of the ExoMars mission. We will present some of the results obtained during the many tests which have already been performed, and will discuss the data which could be obtained by MOMA during the Mars campaign in 2021.