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MicrOmega: an IR hyperspectral microscope to in-situ analyze planetary and small bodies samples, at their grain scale

C. Pilorget, J.-P. Bibring, M. Berthe, and the MicrOmega team
Institut d'Astrophysique Spatiale, 91405 Orsay cedex France (cedric.pilorget@ias.u-psud.fr)

The coupling between imaging and spectrometry has proved to be one of the most promising way to remotely study planetary objects. We propose to use this concept for in situ analyses to characterize the composition of samples at their grain size scale. Coupled to the mapping information, the spectroscopic information provides unique clues to trace back the history of the parent body (planet, satellite or small body). In particular, the microscopic information enables to correlate the different phases within a sample, as well as to identify minor components at a larger scale.

MicrOmega IR is being developed within this scope. It is an ultra miniaturized near-infrared hyperspectral microscope dedicated to in situ analyses, capable of characterize samples in a non-destructive way. It has been selected to fly onboard the ExoMars rover (Pasteur paylaod), expected to be launched in 2018, and more recently on the Hayabusa-2 lander (launch in 2015), aiming at studying a C-type asteroid (1999JU3).

MicrOmega acquires reflectance spectra of $\sim$ 5 mm-sized samples with a spatial sampling of 20 μm. A monochromator, based on an AOTF (Acousto Optical Tuneable Filter), illuminates sequentially the sample in up to 500 contiguous wavelength channels (spectral sampling of $\sim$ 20 cm-1) covering the spectral range of interest (0.9 - 3.5 μm). For each channel, an image is acquired on a 2D detector, building a tridimensional (x,y,λ) image cube.

MicrOmega spectral range and spectral sampling have been chosen to enable the identification of most potential constituents: silicates, oxides, salts, hydrated minerals, ices and frosts, organics, discriminating between specific members in each family (e.g. low and high Ca pyroxenes, forsterite and fayalite, Mg and Al rich phyllosilicates, aliphatic and aromatic phases). These identifications at the grain scale will provide us with important clues to understand the magmatic, tectonic and alteration processes that has experienced the parent body and thus better constrain the scenarios. Importantly, MicrOmega will also be able, and for the first time, to identify carbon-rich phases at a microscopic scale, and to ascribe the mineralogical context in which they nucleated, through the unique capability of coupling spectroscopy to imaging.

Results obtained on ground both on a representative breadboard of the instrument and with a demonstrator developed in the scope of the Phobos Grunt mission will be presented and discussed.