GAS CHROMATOGRAPHY TO CHARACTERIZE THE MOLECULAR COMPOSITION OF EXTRATERRESTRIAL ENVIRONMENTS

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Introduction: The characterization of the chemical composition of extraterrestrial environments is generally one among the primary objectives of planetary exploration probes. The nature and structure of molecules are important information to better understand the physical and chemical porperties of solar system bodies, the way and conditions they were fored from the presolar nebula, and also how the prebiotic chemistry can have been initiated on Earth and possibly elsewhere in the solar system. With this aim, gas chromatography is used since the Viking missions to Mars in the 1970's for the separation and analysis of volatile molecules. Often coupled to mass spectrometry which help determining the structure of the molecules, gas chromatography has been demonstrated to be an efficient instrumentation to characterize the composition of various environements in the solar system as the Titan's atmosphere (Huygens probe), Mars regolith (Curiosity) and hopefully cometary nucleus (Rosetta/Philae). Here we present the main results obtained these two last decades with GCMS instrumentation, using compact GC systems. We also present recent developments on miniaturized GC components that could be used in a very near future to build micro-GCs which could be used in science payloads with limited ressources.

Development of micro gas chromatographs:

Even if the gas chromatographs currently used in space exploration are quite performant, they are relatively resource consuming, especially in the frame of the development of limited science payloads devoted to the exploration of outer solar system objects for insctance. For this reason, our team develops new components and GC systems to meet the technical requirements of these payloads, and scientific objectives. These developments mainly target on : 1. the preconcentration and injection of the sampled molecules; 2. the separation of the molecules with micro-components; 3. the detection with miniaturized and sensitive micro-detectors (Figure 1); 4. components used in the fluidic system to handle the gases (Figure 2); 5. the integration of all these components into a very compact system.

We present here the status of these various developments and the corresponding results.

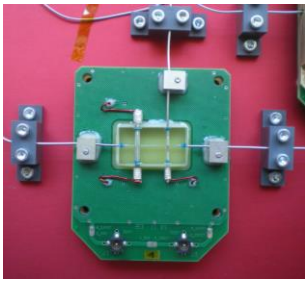

Fig. 1. Miiaturized ionization detector for space exploration GC

Fig. 2. Miiaturized ON/OFF fluidic valve for space exploration GC

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