Development of Micro-Time-Of-Flight Mass Spectrometer for *in situ* gas analysis

Alexandre Sonnette, Frédéric Progent, Jérôme Tupinier, Pierre-Etienne Buthier, Jean-Christophe Lictevout, Sébastien Vigne, CEA, DAM , DIF, F-91297 Arpajon, France

Thomas Alava, CEA, LETI, MINATEC Campus, F-38054 Grenoble, France

CEA is currently developing a micro time-of-flight (µ-ToF) mass spectrometer that can be coupled with gas chromatography and is therefore of great interest for *in situ* gas field analyzes. This device has numerous applications covering a wide range of fields such as the environment, industry, space, etc. In this regard, the device must have a small footprint, be lightweight, low power consuming and easily usable.

In order to meet these constraints, the technology of Micro Electro Mechanical Systems (MEMS) was used. The MEMS developed here consists of a 1 cm x 1 cm silicon chip for linear µ-ToF (Fig 1 A).

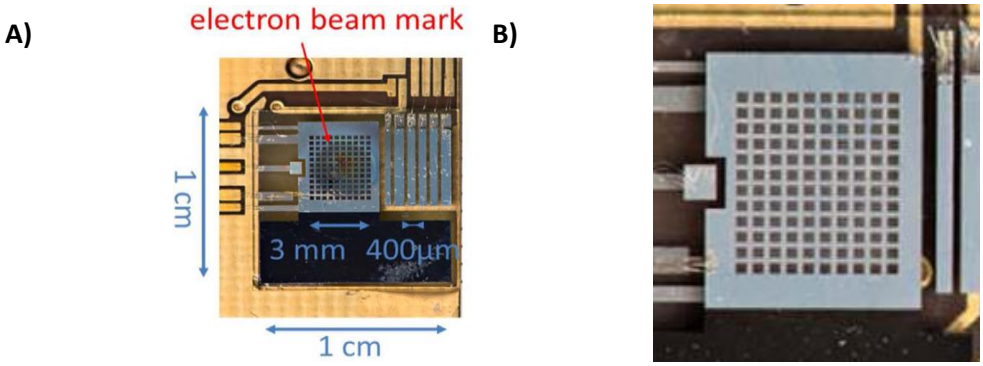

Fig. 1: A) µ-TOF ionization / extraction / focalization stage B) 3 x 3 mm grid zoom

The linear µ-ToF is composed of an ionization stage and a zone of extraction and focalization of the ions produced. In the ionization stage, the gas is bombarded through a grid (Fig 1 B) by electrons to achieve ionization by electronic impact. The electron energy is 70 eV in order to compare the results with NIST libraries. The electrons are produced thanks to a homemade electron gun using thermoionic effect. This gun has been characterized and simplified in order to obtain an intense and well-focused electron beam (2.5 mm diameter) with the minimum device size.

The extraction and focusing of the ions produced is done by means of 6 electrodes constituting electrostatic lenses whose voltages have been optimized. At the end of a time of flight, the ions are detected on a Micro Channel Plate (MCP) and the mass spectrum recorded with an oscilloscope.

Using gas mixtures of rare gas in helium we were able to obtain spectra for concentrations of 100 ppm. Effects of electrodes potentials, gas pressure and geometric layout of gas inlet were studied. This work shows encouraging results and pulls the µ-TOF one step closer towards a fully integrated portable analytical system.