A brighter 0^- source for the NanoSIMS ion microprobe

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The NanoSIMS is a secondary ion mass spectrometer optimized for high precision isotopic and trace element measurements from deep sub-micron areas.

It includes a primary ion beam of reactive species (Cs^+, O^-) at normal incidence with a normal co-axial secondary ion extraction and an objective lens at short working distance. This optimizes ionization yield, primary beam performance (spot size < 50nm) and ion collection. A double focusing Mattauch-Herzog-like magnetic sector mass analyzer incorporates a multi-collection of up to seven EMs or FCs.

The instrument has helped producing scientific results in earth & planetary sciences [2], materials, bio-geochemistry, cell biology and environment microbiology [3].

The vast majority of publications were based on detection of electronegative elements or isotopes, sputtering the sample with cesium ions, with a spot size down to 50nm. Indeed the analysis of electropositive ions required the use of a duoplasmatron ion source in O^- mode, with a much lower brightness than the cesium source. This limited the everyday lateral resolution to 300-400nm in O^- mode.

We present here the recent integration and characterisation of a RF-plasma ion source delivering O^- primary ions. The demonstrated values of beam density and spot size are as good or better compared to the Cs^+, opening new possibilities and new fields of research : alkalies, transition metals, REE, uranides will now be detectable and imaged at low concentration level with better than 50nm lateral resolution.

We will illustrate this development with some preliminary application examples in geosciences.

[1] Hydrogen Isotopes in Lunar Volcanic Glasses and Melt Inclusions Reveal a Carbonaceous Chondrite Heritage. A. E. Saal *et al Science* 14 June 2013: 1317-1320 [2] Zero-valent sulphur is a key intermediate in marine methane oxidation. J. Milucka *et al Nature* **491**, 7Nov2012, 541-546 [3] M. L. Steinhauser et al. Multi-isotope imaging mass spectrometry quantifies stem cell division and metabolism. 516, *Nature*, Vol **481**, 26 January 2012