Combined SIMS-SPM instrument for high sensitivity and high resolution elemental 3D analysis

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Owing to its excellent sensitivity, its high dynamic range and its good depth resolution, Secondary Ion Mass Spectrometry (SIMS) constitutes an extremely powerful technique for analyzing surfaces and thin films. In recent years, considerable efforts have been spent to further improve the spatial resolution of SIMS instruments. As a consequence, new fields of application for SIMS, e.g. nanotechnologies, biology and medicine in particular, are emerging [1],[2].

State-of-the-art SIMS instruments allow producing 3D chemical mappings with excellent sensitivity and spatial resolution. However, several important artifacts arise from the fact that the 3D mappings do not take into account the sample's surface topography. The traditional 3D reconstruction assumes that the initial sample surface is flat and the analyzed volume is cuboid. The produced 3D images are thus affected by a more or less important uncertainty on the depth scale and can be distorted. Moreover, significant field inhomogeneities arise from the surface topography as a result of the distortion of the local electric field. These perturb both the primary beam and the trajectories of secondary ions, resulting in a number of possible artifacts, including shifts in apparent pixel position and changes in intensity.

In order to obtain high-resolution SIMS 3D analyses without being prone to the aforementioned artifacts and limitations, we developed an integrated SIMS-SPM instrument, which is based on the Cameca NanoSIMS 50 [2]. This instrument, an in-situ combination of sequential high resolution Scanning Probe Microscopy (SPM) and high sensitivity SIMS, allows topographical images of the sample surface to be recorded in-situ before, in between and after SIMS analysis. Hence, high-sensitivity high-resolution chemical 3D reconstructions of a number of samples analyzed with this extremely powerful analytical tool will be presented[3][4].

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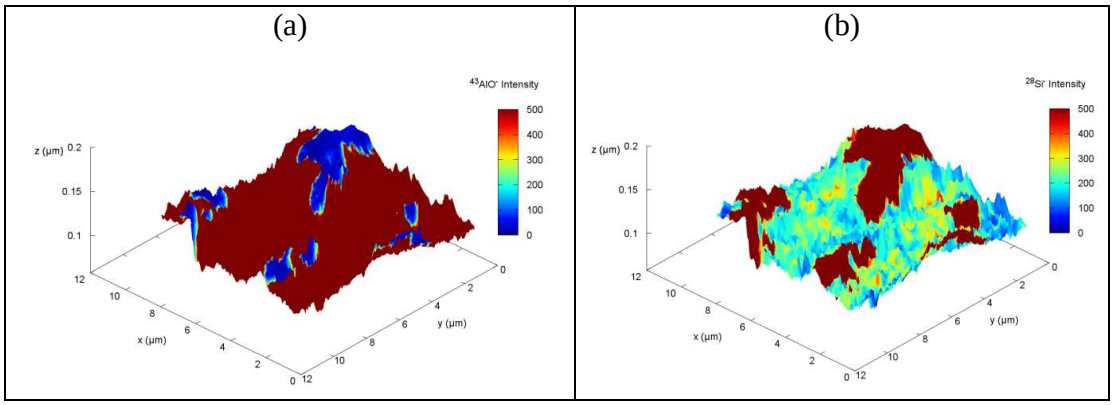

Figure 1: SIMS-SPM 3D reconstruction of topography and the distribution of AlO^- (a) and Si^- (b) signals on LM6 aluminium casting alloy's surface [4].

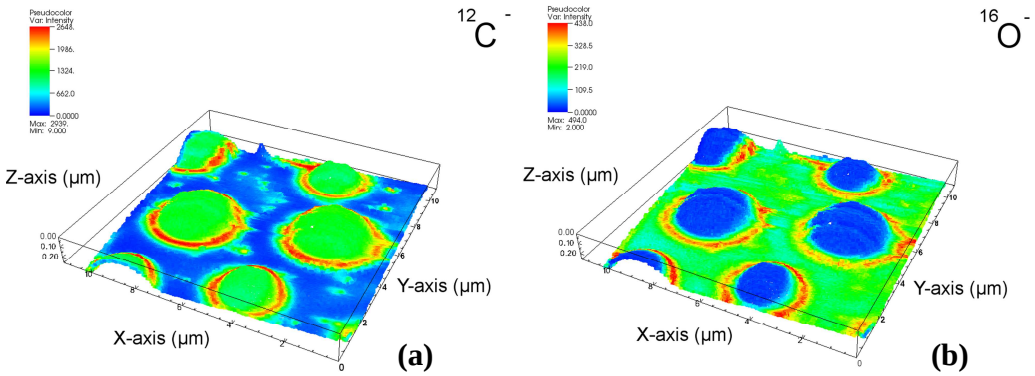

Figure 2: PS/PMMA blend (Field of view: 22.3x17.3 µm^2): (a) Combined SIMS-SPM 3D reconstruction of the $^{12}C^-$ secondary ion signal. (b) Combined SIMS-SPM 3D reconstruction of the $^{16}O^-$ signal, which is characteristic of PMMA [3].