APPORTS OF 3D SEM TO THE CARACTERISATION OF MICROMETEOROIDS CRATERS

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ABSTRACT

Recent advanced in 3D photogrammetry software improve the possibilities of 3D Scanning Electron Microscopy (SEM) and allows to create 3D models of micrometeoroids craters. We will show how this technic can contribute to analyse the geometry and the formation of this craters.

The samples which we evaluated came from dedicated missions (active or passive specific detectors) and from analysis of part of collected satellites / throwers (Glass integrated solar cells from Hubble, parts from exposed structures).

Numerous materials were analysed (ductile, fragile, polymer). The objective of these analyses was to study the behaviour of these materials submitted to hyper speed range impact and to estimate ejected material from front and back faces in order to estimate the number of new created fragments.

Visual and 2D SEM expertise were led and EDS spectroscopy allowed to find residues and to make hypothesis on the sources of fragment. For very small impacts, FIB cuts have been made to exploit tricky and difficult analysis geometries.

Geometric measurements of craters by confocal microscopy were done. It makes possible, thanks to previous calibrations, to estimate the speed / mass of the impactors.

In addition to those technics 3D SEM analyses were carried out. For that, SEM pictures of the crater were taken with different tilting and rotating angle. The number of necessary pictures depends on the complexity of the observed geometry with a number varying from 3 to more than 30. All pictures were then treated with free or commercial photogrammetry software normally dedicated to optical imaging. Recently, many optical photogrammetry software were developed and some of those software are able to produce 3D dataset from SEM images. Therefore, 3D SEM characterisation are possible with minimum investment.

Figure 1: 3D SEM view of a micrometeoroid crater

3D SEM is correlated to confocal optical microscopy in terms of ability to render complex geometries and accuracy. Thanks to the possibility to make pictures at high tiling angles, to the high resolution of the images and to the high depth of focus, 3D SEM appears to be an ideal tool for micrometeoroids craters geometry measurement. Furthermore, by using backscatter electrons images or EDS mapping it is possible to add chemical information into the 3D model.

In addition to 3D models of the micrometeoroid craters can be printed with a 3D printer in order to have a solid model to manipulate.

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