MATERIAL AND MANUFACTURING OF LARES SATELLITE

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Abstract (Topic: Production and maintenance)

LARES satellite body will be the first orbiting object made entirely of tungsten alloy. The choice of this high density material causes a very small surface-to-mass ratio for the satellite. This characteristics make surface perturbations small and the experiment more accurate. Due to the peculiarity of the material used for the satellite, the main properties of the alloy have to be verified against the characteristics declared by the producer. The surfaces of the two spheres to be used for manufacturing the demonstration model of LARES and the flight model of LARES will be analysed with the aim of understanding the homogeneity of the bulk material. The alloy has been prepared by the manufacturer using liquid sintering technique. Since the producer could not guarantee control on the metallic phase distribution we will perform an accurate metallographic analysis on specific specimen of the alloy. The micro-structure will be characterized with Scanning Electron Microscopy (SEM) and the phases will be analysed with Energy Dispersion Spectroscopy (EDS). Micro-hardness on the several phases will be also performed. Particular interest will be devoted to the micrographic analysis of the tungsten alloy screws of the cube corner reflector mounting systems (shown in figure 1).

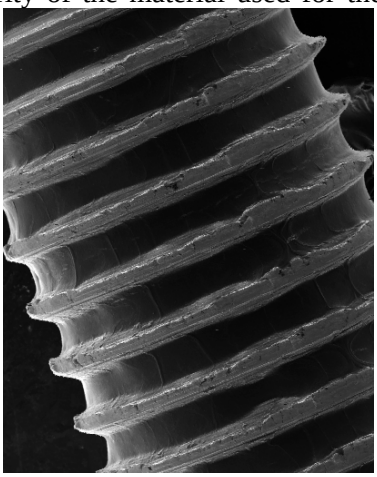

Fig.1

Due to the peculiar alloy used for LARES satellite some concerns arise about the machinability of the material. Although several producers con provide several types of tungsten alloy, and there is a market that uses bulk tungsten material, to our knowledge this material, very seldom used in space, was never machined with tight manufacturing tolerances and severe surface finish. Consequently several tests for machinability and polishing have been performed. Particular care has been adopted for manufacturing spherical cavities that are used to interface the separation system. Also the screws and the retainer ring for the cube corner reflector mounting system are a difficult item to be manufactured in tungsten alloy, being the screw shaft and the ring thickness very small. Special tool for grabbing and moving the semifinished sphere on the tooling machines will be designed. The industrial production process including programming, manufacturing and testing will be described. Figure 2 shows one of the breadboards manufactured to address possible manufacturing problems.

Fig. 2

Acknowledgements
The work is mainly funded by ASI under contract no. I/043/08/0.

References
[1] W.A. Johnson, "Refractory metals and alloys, tungsten", *Metals Handbook, vol 2, properties and selection, non ferrous alloys and special-purpose materials, 10th edition, ASM international, 1990, pp 577-581*
[2] ASTM E8M 2004 "Standard test methods for tension testing of metallic materials"