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DEVELOPMENT AND ANALYSIS OF A NEW ALLOY CANDIDATE FOR LARES 2 SATELLITE

Abstract

LARES 2 is a satellite approved by the Italian Space Agency for testing frame-dragging predicted by the theory of general relativity. The design phase is in an advanced stage and therefore some characteristics of the satellite are already defined. For instance the density of the material has to be as high as possible because the satellite is designed to minimize the effects of the non gravitational perturbations. The orbit of LARES 2 is higher (about 6000 km altitude) than the one of LARES and its mass is lower due to the launch constraints. LARES 2 diameter is a little larger to increase the laser return intensity from the cube corner reflectors (CCRs) mounted on the satellite surface. All the above constraints bring the density of the material in the range between 8800 and 9200 kg/m^3. The satellite is made out of a spherical massive alloy, it is passive and has only CCRs on its surface and so the temperature is controlled only by its thermo-optical properties: infrared emissivity and solar absorptivity. Those need to be such that the satellite temperature is below about 80°C although higher temperatures are possible but may cause malfunctioning of the CCRs. To control the thermo-optical properties, surface treatments can be adopted as long as they are not affected by space environment. That means surface treatments that change the roughness of the surface are preferred to film depositions and painting. In fact this last one is not recommended because long term exposure of paints to space environment are not well known. The alloy has to be non magnetic and must be machinable. Also the mechanical characteristics must be such that to withstand the pressure exerted by the separation system preload along with the vibration during launch. The paper will describe the study performed on some alloys, the techniques adopted to prepare them and reports the main characteristics such as, hardness, elastic modulus, and strength along. Also measured compositions and microstructures performed using electron microscope EDS analysis will be reported. The studies have provided important indications for the selection of the final alloy.