SUPERCAM CALIBRATION TARGET DESIGN

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1. Introduction

The instrument SuperCam, part of the scientific payload of Mars2020 rover, is a next generation instrument, born as an evolution of Curiosity's Chem-Cam [1]. As it happened with ChemCam, a high impact is expected from this instrument in Mars2020 operations along with the scientific outcome of the mission. This instrument includes more analytical capabilities in addition to LIBS, such as Time Resolved Raman Spectroscopy, fluorescence and VISIR spectroscopy or the contribution of the Remote MicroImager, RMI, for morphology of the samples. With all these techniques in one instrument, the complexity of SuperCam's Calibration Target, SCCT, has been increased when compared with Chemcam's, as it can be seen in its final design.

2. Design of the SCCT

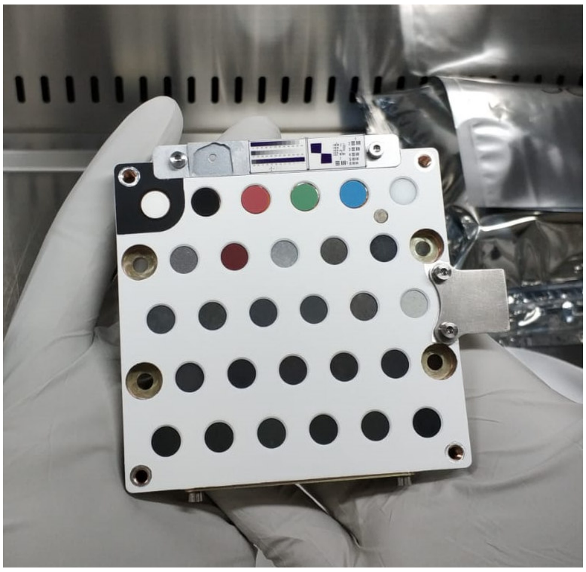

Figure 1. *The final SCCT design.*

The SCCT needs to calibrate the different analytical techniques, and for that different types of targets are needed.

For image calibration a geometric target is included, and also three RGB reflectance standards plus white and dark samples. The geometric target consists on an alumina plate with different gray scales and geometric patterns printed on it. In the case of the reflectance standards, provided by NBI in Denmark, a dust removal system is included in the samples, consisting on a magnet ring that conducts the ferromagnetic dust of Mars to convenient areas, leaving a clear spot in the center of the targets. These reflectance standards are also used for the calibration of the VISIR spectrometer, to obtain the Sun spectrum, characterize dark current, etc.

Besides the imaging and VISIR techniques, the other spectroscopic techniques present in SCAM, Raman and LIBS, need different kinds of samples to obtain a proper calibration once deployed on the Mars surface. A titanium plate is included so the emission lines of the induced plasma of Ti can be used for the wavelength calibration of the three spectrometers inside the body of the Mars2020 rover. In addition to this titanium plate, twenty-two different sintered mineral samples are included, intended to calibrate the chemometric analyses performed by LIBS and Raman. These samples are provided by different laboratories in France under the coordination of IRAP.

One organic sample is implemented to evaluate the impact of the Martian conditions on organic molecular groups with Raman spectroscopy. This sample, together with a diamond sample used to calibrate the Rayleigh emission position, are the two Raman-dedicated samples present of the SCCT.

The SCCT targets are mounted on a holder that needs to keep them safe from environmental and mechanical threats, accommodating very different materials with very different thermo-mechanical behaviors. The design and manufacture of this element was carried out by Added Value Solutions, AVS, in Elgoibar, Spain, counting with support from INTA for the Integration and Testing of the hardware. From the mechanical point of view one the greatest concerns of the design was the survival of the samples to the high- level shocks occurring during landing on Mars. For this reason, each sample is mounted in an individual hole -with an 8-mm window field-of-view for analysis by the instrument-, and fixed using springs, that can deal with the different tolerances and thermal expansions of the samples while providing a good performance in shock environments. The passive reflectance standards include the same system, adequate to the higher mass of the magnetic dust removal system. The diamond sample, on the other hand, and given its low mass and size, is mounted on a borehole, glued to the surface of the holder, while the geometric target and the Ti plate are fastened to the main body, in accordance with geometrical requirements for these elements.

3. Samples

The fabrication of most of the mineral targets has been undertaken in France, with some exceptions as mentioned before. The particularity of the samples makes their characterization especially important, coordinated from Spain, and representing a joint effort from IRAP [2] in France, and UVA, UPV-EHU [3] and UMA in Spain. The samples are characterized using different techniques to assess their features in terms of homogeneity either from the elemental composition point of view, and from the mineral phases point of view. Both features are analysed carefully since they are affected not only from the original raw material used for the fabrication of the samples, but also by the sintering process.

The twenty-two mineral samples included in the SCCT were selected by a dedicated scientific team, taking into account the mineralogy of the landing site of Mars2020 rover (Jezero crater), while also bringing samples representing major mineral groups and compositions, including members of the pyroxenes, feldspars, silicates or phosphates among others.

4. SCCT current status

The SCCT Flight Model has been already delivered to JPL in Pasadena, being the first component of SuperCam to be delivered. Previous to this delivery, the SCCT successfully passed during the year 2018 its qualification campaign.

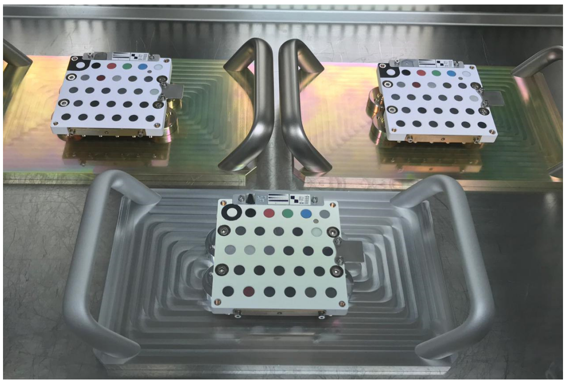

Figure 2. *SCCT EQM, FM and Spare together after integration at INTA's facilities.*

During the SCCT qualification campaign the hardware was tested for Random vibration, Quasistatic Loads and 3500 g shock tests at CTA, Vitoria. This high g environment is due to the pyrotechnic wheel release system of the Rover. This last shock test implied extra work since a failure was suffered during development tests. From the thermal point of view, the SCCT was tested by Alter at a temperature range covering from -135 to 80 ºC, going later through a 120 hours 115ºC DHMR at INTA. This successful qualification campaign assures that the hardware delivered will survive to the launch, cruise, landing and the prime operation time.

The SCCT FM model already passed through the acceptance campaign and the delivery review, being right now stored at JPL facilities waiting for its integration on the Mars2020 Rover.

5. References

[1] S. Maurice et al. (2015) *LPSC XLVI* Abstract #2818.

[2] A. Cousin et al. (2018) *LPSC XLVIII.*

[3] J.M. Madariaga et al. (2018) *LPSC XLVIII.*