BLACK COATINGS FOR COMBINED STRAY LIGHT AND THERMAL PASSIVE MANAGEMENT FOR THE CHALLENGING ENVIRONMENTAL CONDITIONS OF SOLAR ORBITER

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ABSTRACT

In the context of ESA’s Cosmic Vision 2015-2025 scientific program, Solar Orbiter (SolO) represents the first M-class mission, currently under implementation for a launch planned in 2017.

One of the SolO solar remote-sensing instruments is the Multi Element Telescope for Imaging and Spectroscopy (METIS), under development by an Italian consortium ATI composed by CGS and TAS-I. METIS is a coronagraph that will perform simultaneously broad-band imaging in visible light and narrow-band imaging in UV of the Sun corona with unprecedented spatial resolution.

The surfaces of several Ti-6Al-4V components of the METIS Optical Unit shall have a very low reflectance in order to minimize the straylight; so the application of ACKTAR Magic Black™ coating was foreseen. An example is represented by the internal surface of the Inverted External Occulter (IEO), the front part of the instrument which being exposed to the direct solar flux experiences challenging environmental conditions: 450°C is maximum qualification temperature, whereas Acktar’s Magic Black™ qualified maximum temperature was 380°C.

Then a dedicated thermal-vacuum cycling test (100 total cycles, -120°C ÷ 450°C) was conducted to qualify the Magic Black™ coating degradation concerning optical (reflectance), thermal (\(\alpha\) and \(\varepsilon\) values, to correctly calculate radiative heat transfer of the METIS parts during mission) and mechanical performances. The following success criteria were considered: total reflectance at wavelengths of 400-1000nm <5%, degradation of absorptance \(\alpha\) and emissivity \(\varepsilon\) to be <10% and surface resistivity < 5 kΩ/square.