

Category: Materials, Coatings & Processes

Reference: TD-DE-1052

White, UV-reflective coating

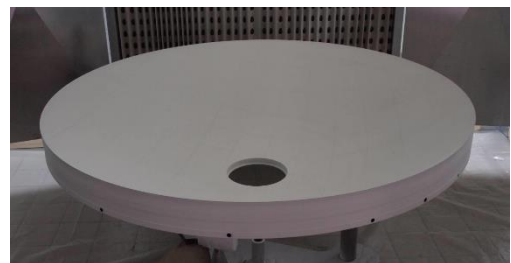
For a mission to the planet Mercury (mission: BepiColombo) a special coating had to be developed, because previous coatings were not suitable. All normal paints and also established coatings for satellite components were unsuitable and failed in tests; i.e. there was chipping in the thermal UV vacuum chambers of ESA or the coatings turned black.

Particular challenges were. Duration and mechanical and thermal stresses.

"We are flying into a pizza oven".
Quote from the lead ESA project manager.

Required properties:

- As thin as possible, applicable to max 1mm thick metal.
- As white as possible at 500°C in high vacuum and UV radiation <180nm
- Low absorption, diffuse reflection and high emission of radiation
- Excellent thermal shock and temperature resistance
- Excellent adhesion
- Slow aging in the range of 5-10 years
- Scalable and can be applied by hand
- As free of organic carbon as possible
- No chemical pretreatment of the substrate



Coating durability requirements:

- Thermal shock of -200°C (-270F) and 500°C (840F)
- Intense UV radiation
- Remains white in vacuum under harsh UV radiation and adheres under the harshest conditions
- Can cool the underlying component by up to 160°C (320°F)
- REACH compliant

Substrates used: Titanium, Titanium Foil and Aluminum

The final result is the following coating:

Al2O3	matt, white, abrasion resistant
h-BN	matt white, good TWB, coating material
Potassium silicate	Reflective binder
C-content	almost zero

- aqueous coating system for (blasted) Ti-Grade5 /Ti- Grade 2 and aluminum surfaces (0.02mm >>1mm thickness)

- coating is sprayed by hand using HVLP spray gun and can be used for complex 3D geometries up to 1700mm
- coating only needs to be dried but can be baked at 500°C in air /1h
- coating can be sealed with a thin layer of boehmite glass to avoid contamination
- Cleaning with ozone and/or UV-C radiation possible

The now patented coating was mission standard on BepiColombo and is also successfully used on SoLo (Solar Orbiter) and on ISS (DESI platform).

Innovative Aspects:

Thermo-optical properties

- excellent a/e ratio before and after life cycle test with 28,000 ESH (equivalent sun hours) at 430°C in vacuum (200nm -400nm UV intensity: 11 ± 2 solar constants acc. to ECSS-Q-70-09A) incl. IR component
 - a/e: before test: 0.25 → a: 0.2 and e: 0.85
 - a/e: after test; <0.4 → a: 0.34 and e: 0.87
- Completely diffusive coating with no measurable specularity.
- Pores can be sealed with a sol-gel glass in combination with UV/O3
- O3/UV cleaning without sealing also possible
- Very good substrate adhesion; wallpaper test with peel strength > 220 g/cm after 28,000 ESH UV was passed (following ASTM D 3359)
- Excellent ductility and TWB: -196°C to 500°C in 30 seconds (repeated 10 times)
- Layer thickness adjustable between 10 and 100µm with an accuracy of 5µm
- Substrates: Ti6Al4V, Ti, but also niobium C103; C/SiC; aluminum
- Tmax in vacuum at least: 550°C

Application Areas:

Everywhere where high temperature and UV resistant requirements exist.

Cooperation:

The company offers contract coating, customized development services (joint development projects close to the market with production perspective) and upscaling work.