



THIN FILMS ON A LONG JOURNEY

Mercury is the smallest and innermost planet of our solar system. To date it has only been visited by two American space probes. The ESA (European Space Agency) and JAXA (Japan Aerospace Exploration Agency) are now planning the joint BepiColombo mission to collect new information about this virtually unknown planet. Coated parts from the Fraunhofer IST will be on board.

The BepiColombo mission

The Mercury probe BepiColombo has three components: a European orbiter, a Japanese orbiter and a propulsion module. It has a total length of approximately six meters and weighs around four tonnes with a third of this taken up by fuel. The two space probes will assist in studying Mercury's magnetic field, the structure and other aspects of the planet. It is hoped that conclusions may be drawn regarding the development of the planet and the origins of our solar system. The mission counts as one of the most difficult and technically challenging missions ever planned by the ESA. The total cost of the project (including the operation) is already estimated as exceeding 800 million euros. Overall responsibility for the three-part spacecraft lies with Astrium Deutschland.

The mission is scheduled to start in 2015. The flight will take more than six years with the probes being launched on an Ariane 5 rocket from Kourou, the European spaceport.

Once arrived at their destination the probes will be exposed probably for more than a year not only to marked temperature fluctuations with peaks considerably higher than 300 °C but also to extreme ultraviolet radiation from the sun. In addition, parts of the probes will experience extreme temperature differences due to changing between sun and shade phases.

Thin coatings help in cooling

Cooling louvers made of titanium will protect the valuable cargo from high thermal irradiation. To do so, the louvers are coated with silver. However it is a very complex matter to electroplate titanium directly with silver. To ensure good adhesion of the coating, a preparatory passivation treatment is necessary which involves the environmentally critical use of hydrofluoric acid or other chemicals containing fluorine. There is also a risk here of hydrogen embrittlement of the titanium. To prevent this, the titanium components were first given a thin film of copper in a PVD coating process at the



Fraunhofer IST. The parts thus treated were then coated with silver by means of a very simple electroplating process.

Extremely reliable

Naturally the demands are extremely high which space travel makes of the quality of the coating processes and of the coatings themselves. For this reason the entire production chain for coating deposition at the Fraunhofer IST has been certificated by Astrium and the ESA. Furthermore, all steps in the complete manufacturing sequence for every individual part have been fully documented. A complete set of titanium parts for a functional model was coated back in 2010. Over the two years it successfully passed a series of complex climatic tests.

Outlook

The European orbiter is now being built at Astrium Satellites in Friedrichshafen and the coatings from the Fraunhofer IST are scheduled to start on their long journey to Mercury in 2015.

*1-2 The three-part
Mercury probe BepiColombo
with a European orbiter,
a Japanese orbiter and a
propulsion module.*

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