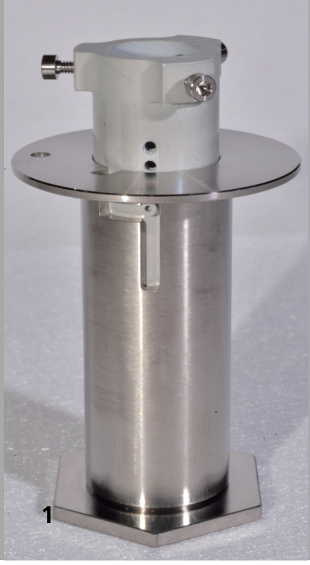

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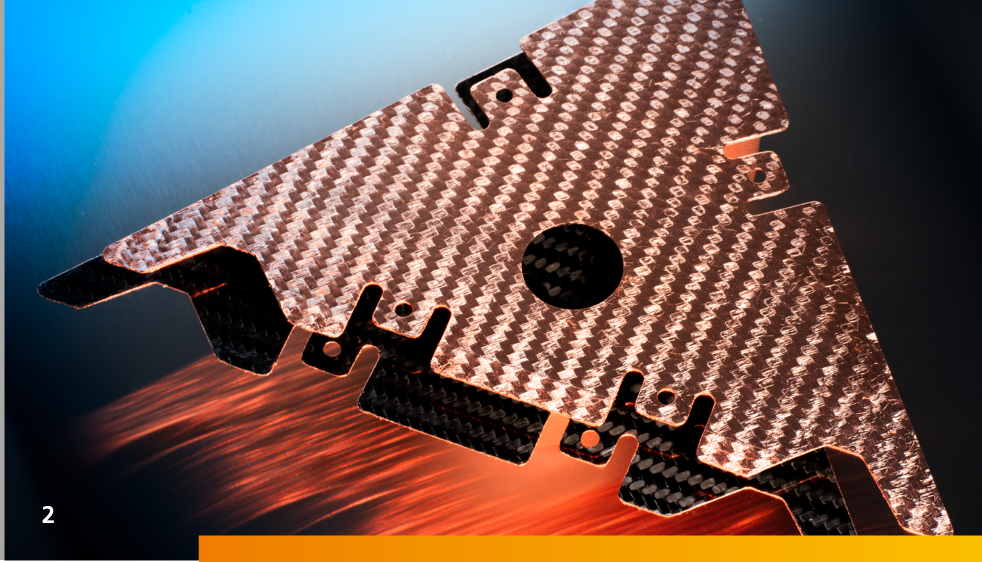

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Extract from the annual report 2014
To the website: www.ist.fraunhofer.de/en.html

# MASCOT – MOBILE ASTEROIDE SURFACE SCOUT

4.6 billion years – this is the age of our solar system as estimated by today's scientists. Investigations into the birth of the solar system have an important part to play in current research. Information about its origin may be provided by the comets and asteroids which came into existence at that time and since then have been traveling through space almost unchanged. The research satellite "Rosetta", for example, reached the Churyumov-Gerasimenko comet in August 2014 and on the 12th of November set down its lander "Philae" on its surface. December 2014 saw the launch of another satellite, the Japanese Hayabusa II, with its "MASCOT" lander, on its way to asteroid 1999 JU-3. Parts coated at the Fraunhofer IST are on board.

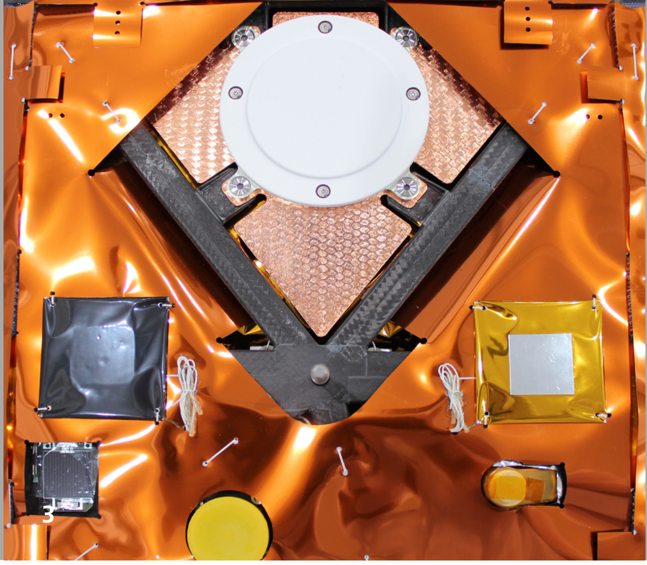
**Separation with the aid of thin films**

One of the special challenges of space travel is that some functions must be successful only once but then with absolute reliability, even after a long time under difficult conditions. When Hayabusa II reaches the asteroid after a trip lasting four years, MASCOT, which is about the size of a shoebox, will be ejected from a height of about 100 meters. To make sure ejection functions safely after such a long flight the Fraunhofer IST coated the surface of the individual components of the separation mechanism between the satellite and the lander. The mechanism is a so-called ejector which consists of a sleeve and a plunger. The latter is restrained by a spring and not released until an impulse is given, which results in the lander frame being pressed out of the satellite. To combine high strength with lowest weight the sleeve has been made of titanium and the plunger from a special aluminium alloy.

It was the task of the Fraunhofer IST to coat the surface of the plunger. The customer, DLR (the German Aerospace Center), set high requirements for the coating: corrosion protection, wear-resistantance, no cold welding and a very low coefficient of friction were all mandatory. Several combinations of material were tested to achieve this. Ultimately successful was an anodized layer combined with polytetrafluoroethylene (PTFE) particles on and beneath the surface. Fig. 1 shows the separation mechanism.

**The CFRP antenna**

Once it has touched down on the asteroid, the lander will collect various data. It is equipped for this with an infra-red microscope, a camera, a radiometer for determining the temperature and radiation properties as well as a magnetometer for measuring the magnetic field.




1 *Mechanism for separating the satellite and the lander.*

2 *Metallized CFRP base plate of the antenna.*

3 *Patch antenna built into the MASCOT lander.*

To send the collected data from the lander to Hayabusa II and from there to earth, the DLR uses a so-called patch antenna – in other words, an antenna variant consisting of a polymer carrier and a metallized top and bottom face. The base plate is made of carbon-fiber-reinforced plastic (CFRP). To ensure the plate reaches the electrical conductivity required for an antenna it was electroplated with copper at the Fraunhofer IST. What was required here was a homogeneous coating thickness as well as very good adhesion of the metal coating to the CFRP under extreme changes in temperature. The procedure used had already been developed at the Fraunhofer IST for the CFRP waveguides in the European Space Agency's "Sentinel" mission and were successfully used there. The metallized base plate and also the complete patch antenna installed in the lander are shown in Figs. 2 and 3.

# CONTACT

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