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FRAUNHOFER INSTITUTE FOR SURFACE ENGINEERING AND THIN FILMS IST

PRESS RELEASE

A filter from the Fraunhofer IST is being used in the Mars Rover

Technology from the Braunschweig Fraunhofer Institute lands on Mars

In the new Mars Rover "Perseverance", an optical interference filter from the Fraunhofer Institute for Surface Engineering and Thin Films, in short Fraunhofer IST, has been installed. It assists NASA's Rover in the investigation of the dust in the planet's atmosphere – and it does so under the most extreme conditions.

After more than half a year and a journey of 472 million kilometers, the new Mars Rover "Perseverance" has successfully landed on Mars and, since its landing, has been delivering spectacular images of our neighboring planet. The goal: to obtain important information concerning possible life on Mars. For this purpose, the one-tonne Rover is equipped with extensive, highly sensitive technology – some of it from Germany. A special optical filter from the Fraunhofer IST in Braunschweig has been integrated.

Specifically, the filter is located in an optical sensor for dust characterization in the "Mars Environmental Dynamics Analyzer", or MEDA for short. "The MEDA performs weather measurements, including wind speed and direction, temperature and humidity, as well as radiation and the quantity and size of dust particles in Mars' atmosphere," said Dr. Michael Vergöhl, Head of the department of Low-Pressure Plasma Processes at the Fraunhofer IST in Braunschweig, outlining the system. His department uses a special coating system, the EOSS® sputtering system, to develop, amongst other items, high-precision optical filter systems. "Our developments are always custom-made products – in this case, the Rover is fitted with a bandpass filter manufactured specifically for this particular application."

Mars dust provides an insight into climate history

Over the course of the mission, the Mars Environmental Dynamics Analyzer is intended to make a significant contribution towards preparing for human exploration of Mars. In this context, data will be provided regarding daily weather reports, information on radiation and wind patterns, and insights into the dusty surface which dominates the planet. Incidentally, this surface is the reason why Mars is also called the "Red Planet": The reddish coloring is caused by the iron oxide dust – rust, so to speak – that covers the surface. The dust on Mars reveals a great deal about the history of the planet and provides an insight into the climate history there.

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Project Manager Stefan Bruns explained the special challenges which are associated with the project: "The so-called 'angular shift', i. e. the distortion of the measurement through obliquely incident near-infrared light to be detected, must be as minimal as possible, whilst the filter must simultaneously withstand the extreme gamma, proton and ionizing radiation present locally. In addition, a fundamental aspect is temperature stability: Even at very low temperatures of down to -120 degrees Celsius, the transmitted wavelength range of 950 nm, known as the passband, must not shift significantly." Over a period of almost four years prior to the mission, the Instituto Nacional de Técnica Aeroespacial (National Institute of Aerospace Technology), or INTA for short, carried out extensive and sometimes harsh tests in a vacuum, focusing thereby on pressure and temperature conditions. For example, the filter was subjected to 3,000 rapid temperature changes between -135 ° and 45 °C. "After all, the system should not fail after just a few 'Mars days'," explained Bruns.

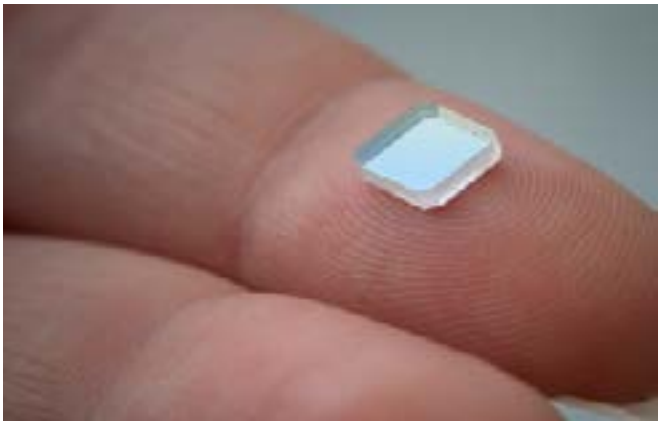
Stable performance under extraordinary environmental conditions

MEDA's sensors are integrated into the Rover at various positions, including the "neck" of the instrument, the front panel and the interior. Sensors for radiation exposure and dust are located on the top of the Rover. Deployed there: The filter from the Fraunhofer IST. "The task of the filter is to let through light solely in the 'near' infrared range. The aim is to hereby identify the dust in the Mars atmosphere," explained Stefan Bruns. The filter was requested by the Spanish space organization INTA.

The IST scientists manufactured the so-called bandpass filter on the EOSS® coating system by means of magnetron sputtering. In order to ensure that the extremely thin individual layers of the filter are deposited with high precision and homogeneity, the optical monitoring system MOCCA$^{+®}$, also developed at the IST, is used. Bandpass filters are, of course, not only for interstellar use. Michael Vergöhl, Head of the department, said: "Bandpass filters are regularly used for applications on Earth. The special feature of these filters is that they remain very stable, even under extraordinary environmental influences." Depending on the framework conditions, the filters are specially developed for each specific application.

Further information on the work of the Fraunhofer Institute for Surface Engineering and Thin Films can be found at www.ist.fraunhofer.de, and detailed information on the Mars mission is available at mars.nasa.gov.

Technology from the Fraunhofer IST on Mars: The interference filter is a component of an optical sensor for dust characterization in the "Mars Environmental Dynamics Analyzer", or MEDA for short. ©Courtesy NASA/JPL-Caltech



Interference filter for the Mars mission. ©Fraunhofer IST, Falko Oldenburg

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