PRESS RELEASE

Spectrometer grating for ESA's Sentinel-4 climate mission

Laser World of Photonics 2025: Fraunhofer IOF presents robust diffraction gratings for space applications

Jena / Munich (Germany)

In summer 2025, the European Space Agency ESA plans to launch the MTG-S1 satellite from the third generation of the Meteosat series. The geostationary satellite will significantly improve the accuracy of weather forecasts for Europe. On board is a key component from the Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena: a high-precision diffraction grating. From June 24 to 27, Fraunhofer IOF will be presenting a copy of this complex optical component at the Laser World of Photonics trade fair in Munich.

MTG-S1 will carry several scientific instruments, including the Copernicus Sentinel-4 spectrometer. This instrument collects detailed hourly data on the three-dimensional distribution of trace gases such as ozone, nitrogen dioxide and sulfur dioxide as well as aerosols in Europe's atmosphere. A key component of this spectrometer, the high-precision reflection grating, was developed and manufactured by Fraunhofer IOF.

Manufacturing technology for maximum demands

"The technology used was originally based on gratings for compressing ultrashort laser pulses," explains Dr. Falk Eilenberger, head of the Micro- and Nanostructured Optics department at Fraunhofer IOF. "Our aim was to develop extremely robust gratings with maximum reflectivity and simultaneously high angular dispersion as well as low polarization dependence."

Such gratings are produced in several high-precision steps. First, various dielectric layers are deposited to a substrate, with the top layer consisting of silicon dioxide (SiO_2). The desired nanostructure is then created using electron beam lithography and reactive ion etching. This is followed by lithographic coating with black chromium for the aperture, before the component is cut into its hexagonal shape and assembled with an accuracy of a few micrometers.

Many years of expertise for demanding space missions

The researchers at Fraunhofer IOF have decades of experience and an extensive portfolio of space-certified technologies. For the ESA FORUM mission planned for 2027, for

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example, the institute developed a diamond beam splitter with a special anti-reflective nanostructure. For the CO2M mission, also an ESA initiative, Fraunhofer IOF is supplying complex spectrometer optics, each consisting of a grating and two prisms. These components were joined by direct bonding using plasma-activated surfaces.

"Fraunhofer IOF's multiple involvement in various space missions is evidence of the ongoing development of corresponding expertise. Some of the processes used were developed and qualified specifically for special missions. What sets us apart is that all the necessary process steps, from design and production through to system integration, can be implemented directly here on site at Fraunhofer IOF," says Eilenberger.

Program of the European Union

Co-financed by the ESA

The spectrometer grating for Sentinel-4 was developed and manufactured at Fraunhofer IOF on behalf of Jena-Optronik GmbH. Jena-Optronik in turn integrates the grating into the spectrometer.

Presentation at the Laser World of Photonics 2025

Interested visitors can experience Fraunhofer IOF's space-certified technologies, including the precision grating, at the Fraunhofer booth A2.415.

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About Fraunhofer IOF

The Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena conducts application-oriented research in the field of photonics and develops innovative optical systems for controlling light - from its generation and manipulation to its application. The institute's range of services covers the entire photonic process chain from opto-mechanical and opto-electronic system design to the production of customer-specific solutions and prototypes. At Fraunhofer IOF, about 500 employees work on the annual research volume of 40 million euros.

For more information about Fraunhofer IOF, please visit: www.iof.fraunhofer.de

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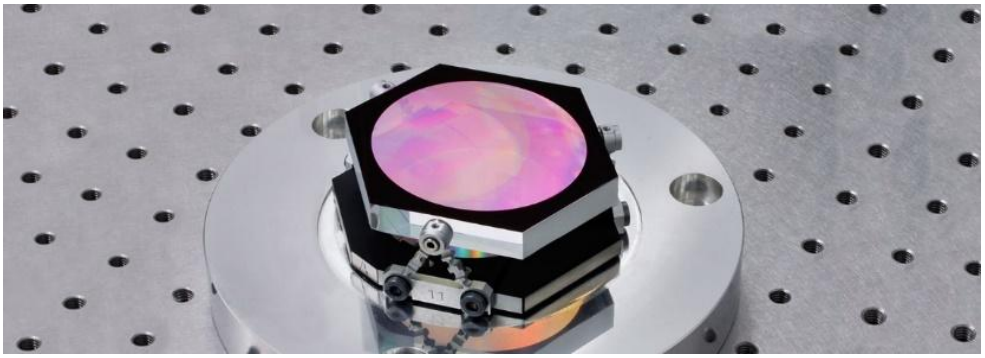
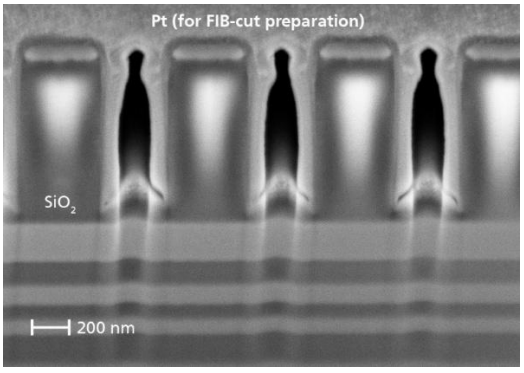
Press images

The following images are available in the Fraunhofer IOF press section at https://www.iof.fraunhofer.de/en/pressrelease.html for download.



The nanostructured grating for ESA's Copernicus Sentinel-4 instrument is mounted with micrometer precision. © Fraunhofer



The special nanostructure of the NIR grating for the Sentinel-4 instrument can be seen under the scanning electron microscope. © Fraunhofer IOF

Logo of the Copernicus Sentinel-4 mission © ESA