PRESS RELEASE

ILA 2018: Direct bonding of diffraction gratings and prisms for earth observation

Experts from the Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena are able for the first time to connect compact prism grid systems by direct bonding permanently and without adhesives. The technology is particularly suitable for precision optics in vacuum and has been tested for space use.

If environmental problems are considered on a global scale today, satellite observations are often used. The satellites with their spectrometers revolve around the earth and record greenhouse gas emissions, land use or oxygen production above the jungle. The demands on the spectroscopic systems are immense: On the one hand, they should be highly precise and as compact as possible, on the other hand, they have to withstand the shocks at take-off and also function stably during many years of missions. At the Fraunhofer Institute for Applied Optics and Precision Engineering IOF, a technology has been developed with which the core components of spectrometers can be built even more compact and robust in the future.

Direct bonding of glass components

From semiconductor manufacturing it is known that glass wafers can be permanently bonded together by direct bonding. The experts at the Fraunhofer IOF have developed this technology so that for the first time even thick and rigid components - such as prisms - can be connected. The method is based on the formation of covalent oxygen bonds between the different glass surfaces. The process is best described by the equation X-Si-OH + HO-Si-X → X-Si-O-Si-X + H2O ↑, where X stands for the glass matrix of the two joining partners.

For the process, both surfaces are brought to a flatness of at least 20 nm and a roughness of 0.5 nm RMS by magneto-rheological and chemical polishing. Then both surfaces are activated. The actual joining process takes place in cleanroom conditions under normal atmospheric pressure, allowing the process to be flexibly adapted to different component geometries and dimensions.

The advantages for the optical systems are considerable: bonding eliminates optical interfaces, and for a prism grid prism PGP system the number reduces from six to two relevant areas. The losses are correspondingly lower, there is less stray light. Furthermore, the component has a high thermo-mechanical stability, which translates directly into the wavefront accuracy.

Editorial Notes
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The technology was developed for a satellite mission and the PGP combination successfully qualified for the mission after the demanding thermal and mechanical tests. In addition to applications in the aerospace industry, the technology is of course also suitable for other vacuum applications, for example for precision optics or highly sensitive interferometers.

The Fraunhofer IOF will be presenting the direct bonding and other technologies from 25th to 29th April 2018 at the joint Fraunhofer booth no. 202 in Hall 4 at the ILA in Berlin.

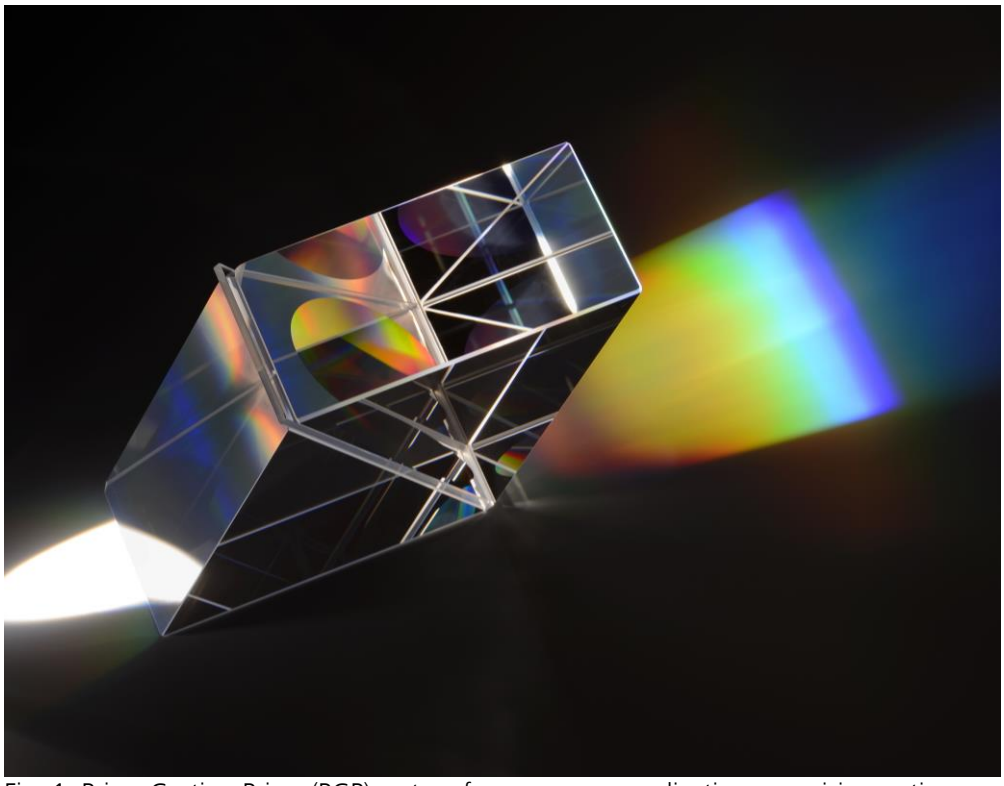

Fig. 1: Prism Grating Prism (PGP) system for aerospace applications, precision optics or highly sensitive interferometers. ©Fraunhofer IOF