Optics

EOSS—A New Industrial Production System for Precision Optical Coatings

Precision optical coatings are key technologies for modern optical systems. These complex coatings impose stringent requirements for uniformity, process stability and productivity on an industrial scale. Stefan Bruns, Philipp Farr and Michael Vergöhl from the Fraunhofer Institute for Surface Engineering and Thin Films IST in Braunschweig have developed a unique coating technology for precision optics systems that meets these requirements and is already in use in industry. Their efforts have earned them the Joseph von Fraunhofer Prize for 2026.

With their development of the EOSS (Enhanced Optical Sputtering System) production system, the Fraunhofer IST research team has ushered in a new era in precision optics. "Our shared goal was to achieve industrially scalable, efficient and flexible manufacturing of high-precision optical coatings. With the EOSS production system and the complementary control and monitoring software MOCCA+ (Modular Optical Coating Control Application), we have succeeded in translating scientific excellence into an industrial product that sets global standards. The applications range from autonomous driving and medical technology to smartphone optics, telecommunications and aerospace," explains Michael Vergöhl, Head of Optical and Electronic Systems at Fraunhofer IST and the scientific driving force behind the project. He has pursued the vision of revolutionizing the industrial application of precision optics since 2012.

What makes the EOSS system unique?

The EOSS system makes the first use of rotating double-tube cathodes, so-called rotatable magnetrons. Combined with novel mixed metal/metal-oxide targets, this yields an extremely stable coating process that does not rely on reactive gases. The spatially separated plasma post-reaction and the upward-facing, low-particle design ensure uniform, reliable production of even the most highly demanding optical components.

A further technological breakthrough is the simultaneous double-sided deposition of optical coatings. "The ability to simultaneously coat both sides doubles productivity and enables the coating of extremely thin substrates with the highest process stability and uniformity. This was previously unthinkable," explains Michael Vergöhl. The production system's performance data is impressive. Uniformity is extremely high and stable at nearly 100 percent over a production period that is up to ten times longer than for previous systems. Combined with the possibility

of reproducible gradient profiles and the high degree of automation, this demonstrates the technology's industrial maturity.

MOCCA+—custom measurement technology for production monitoring

The hardware is supplemented with MOCCA+, a modular model- and data-driven control and monitoring application consolidating process control, data acquisition and analysis. MOCCA+ enables real-time monitoring of the entire coating process—a first in industrial production. This also ensures the quality of the precision optical systems while maximizing the productivity of the EOSS systems. "With MOCCA+, we have laid the foundation for transparently controlling complex coating processes with comprehensible documentation. Real-time monitoring improves not only quality but also production efficiency," stresses team technical lead Stefan Bruns.

Industrial commercialization and commercial success

"Our platform is pioneering the technology and provides maximum flexibility for new design requirements," explains Philipp Farr, Group Manager for Precision Optical Coatings at Fraunhofer IST, who is primarily responsible for the industrial commercialization of the EOSS platform and the associated coating processes. Farr has successfully boosted progress in key projects, including that of highly compact multi-gradient filters in the RAINBOW project in collaboration with Airbus Defence and Space, VISTA GmbH and the Fraunhofer Institute for Applied Optics and Precision Engineering IOF. Funded by the ESA, the RAINBOW project is advancing hyperspectral remote sensing to support more precise and sustainable agriculture. Another successful example is the development of laser protection filters for aviator glasses, which are already being successfully transferred to mass production. "Collaboration within the team and with our partners was decisive in the practical industrial implementation of this innovation and in enabling its commercial success. We are proud to also see our solutions gain international recognition," says Farr.

The project's commercial success underscores its significance. Many EOSS production systems have already been brought to market through partners, for instance under the name FHR.STAR/EOSS in collaboration with FHR Anlagenbau GmbH and under the name OPTA X (the next generation) in collaboration with VON ARDENNE GmbH. With the EOSS production system and MOCCA+, the Fraunhofer team has developed a key technology that is sustainably transforming industrial manufacturing of precision optical coatings—to the benefit of science, industry and society.

Joseph von Fraunhofer Prize

Since 1978, the Fraunhofer-Gesellschaft has awarded the annual Joseph von Fraunhofer Prize to its employees for outstanding scientific achievements in developing solutions for application-related problems. This year, three prizes, each worth 50,000 euros, were awarded to groups of researchers from different institutes.

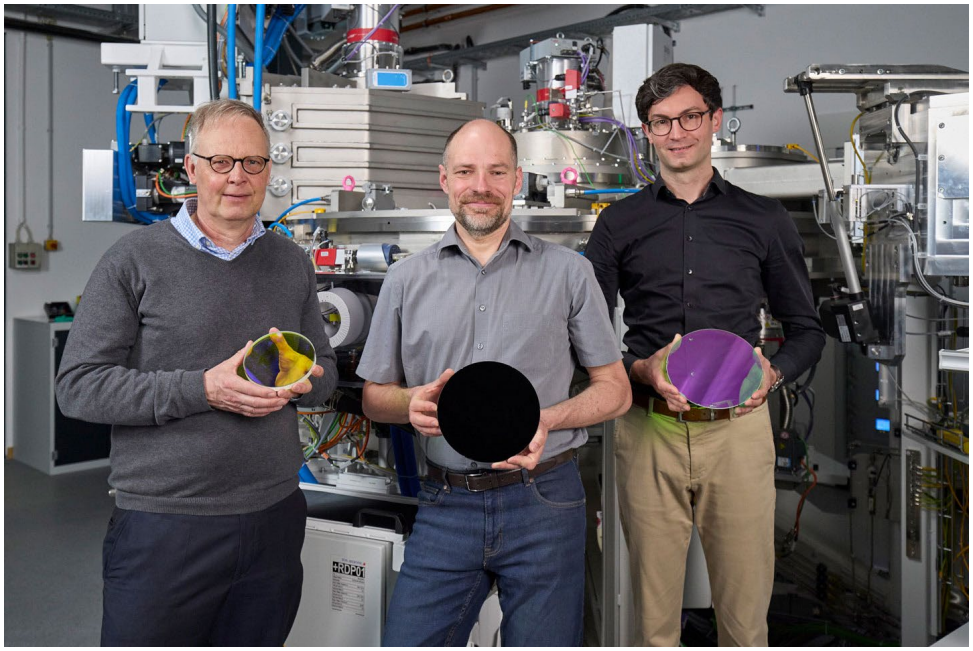

Fig. 1 Winners of the 2026 Joseph von Fraunhofer Prize: Michael Vergöhl, Stefan Bruns and Philipp Farr (from left) from Fraunhofer IST © Fraunhofer / Piotr Banczerowski

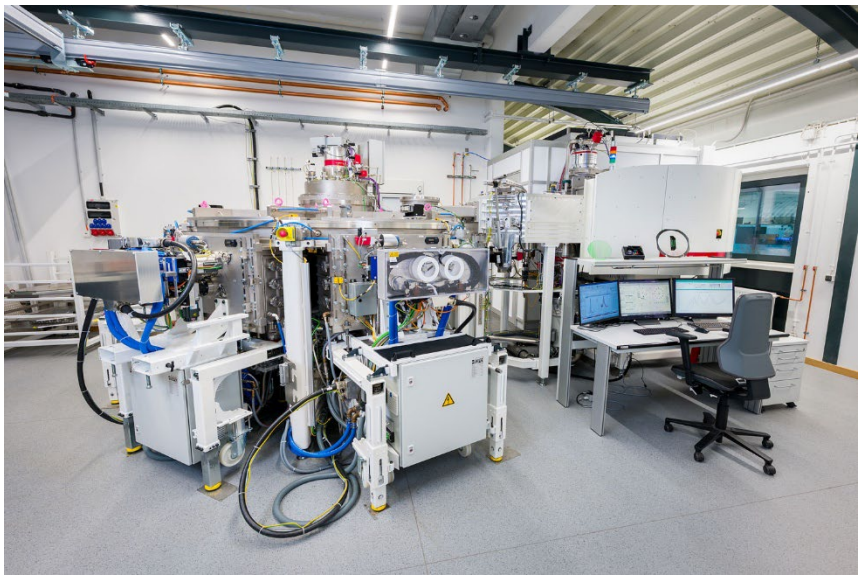

Fig. 2 The latest generation of the EOSS production system is designed for double-sided coating. © Fraunhofer IST / Daniel Böhme

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