PRESS RELEASE

Future-oriented CMOS-integrated Quantum Sensing for Highly Sensitive Magnetic Field Imaging

The Fraunhofer Institute for Photonic Microsystems IPMS is collaborating with the Max Planck Institute for Chemical Physics of Solid States CPfS on an innovative project called "OptoQuant." This project is funded under the Fraunhofer-Max Planck cooperation program and aims to develop CMOS-integrated micro-optoelectronic quantum sensors for highly sensitive magnetic field imaging at room temperature. Initial results will be presented as a talk at SPIE Quantum West 2026 and at SPIE AR/VR/MR 2026 (January 20-22, 2026, booth number 6429, in San Francisco, USA) with an exhibit.

The principle of quantum sensing is based on NV diamonds (Nitrogen-Vacancy diamonds), which exhibit unique properties due to defects in their crystal structure. NV centers can be optically excited and emit light, whose photoluminescence is used for the detection of magnetic fields, electric fields, or temperatures.

Patrick Engelmann, project leader at Fraunhofer IPMS, highlights the benefits of the new approach: "The newly developed CMOS-based platform for quantum sensing can be easily operated at room temperature due to NV technology, where otherwise complex cryotechnology would be required. By integrating the light source, detector, microwave, and readout on a chip, the system is significantly miniaturized and consumes very little energy. Furthermore, we can achieve spatial resolution in the micrometer range using multi-channel arrays instead of single measurement points. The system is robust and portable, as it does not require lasers or optics."

The development of these CMOS-integrated quantum sensors opens new horizons in various fields, from geophysics for exploring deformations of the Earth's magnetic field to medicine for heart and nerve monitoring, and potentially as an interface for brain-machine interaction. This technology addresses challenges that have not been resolved previously, such as portable magnetic field quantum sensors for rapid, highly sensitive on-site analyses and simplified laboratory workflows.

At Fraunhofer IPMS, the required CMOS backplane is designed and manufactured in a commercial semiconductor facility. Afterwards, OLED light sources will be integrated onto the chip at the institute. The precise alignment of the NV diamonds to the sensor pixels is crucial for optimal measurement results. The work builds on the available

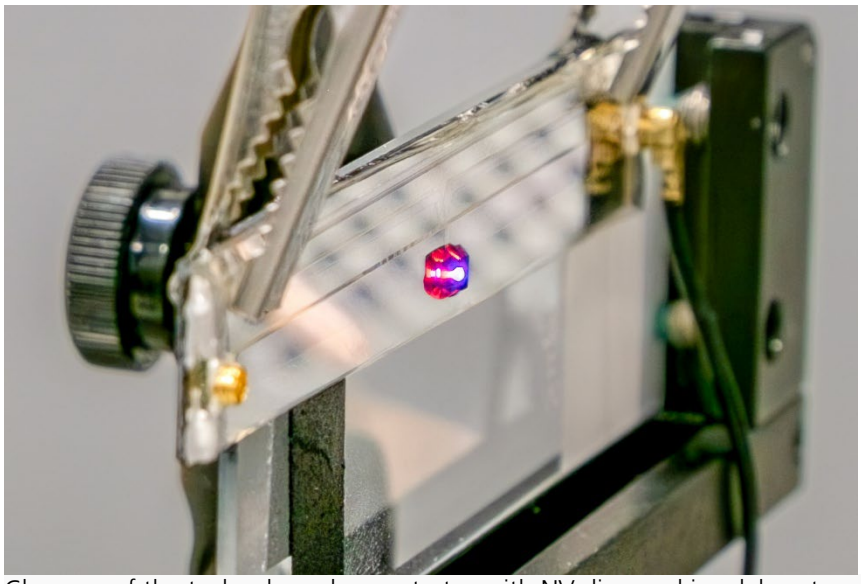
Editor
Ines Schedwill | Fraunhofer Institute for Photonic Microsystems IPMS | Phone +49 351 8823-238 |
Maria-Reiche-Straße 2 | 01109 Dresden | www.ipms.fraunhofer.de | ines.schedwill@ipms.fraunhofer.de

expertise at the institute for the integration and manufacturing of OLED-on-silicon devices, specifically based on the so-called "bi-directional" microdisplays with image capture and playback functionalities on a chip.

The MPI CPfS is engaged in the joint project with measurement methodology, as well as the investigation of quantum optical material in the form of NV diamonds and alternative materials for this application.

So far, the joint integration of OLED and antenna, as well as the excitation of the NV center in a technology demonstrator, has been demonstrated. Work is still ongoing on the complete CMOS integration of the sensor system, including photodetectors and the complete readout circuit. Initial industry partners have already expressed interest. Verification in initial research applications is expected within three to four years. Upon positive validation, the platform can be quickly adapted to specific applications and transitioned to pilot production.

Image Material



Close-up of the technology demonstrator with NV diamond in a laboratory setup showing visible red photoluminescence of the NV centers excited by an OLED © Fraunhofer IPMS

Fraunhofer IPMS at Photonics West 2026, SPIE Quantum West 2026, and SPIE AR/VR/MR 2026:

Exhibition stands: PW26 => 4521; SPIE AR/VR/MR 26 => 6429

Presentations:

Dr. Uwe Vogel: "Ultra-High-Definition (UHD) display and imaging for Near-to-Eye (NTE) AR/VR/MR: requirements and achievements," January 19, 2026, 12:10 PM - 12:35 PM PST

Sukhrob Abdulazhanov: "Improved design of mmWave test structures for BEoL varactors based on HfO2/ZrO2 superlattice," January 19, 2026, 2:35 PM - 2:55 PM PST

Dr. Thilo Sandner: "Investigations and optimization of positioning dynamics of a vectorial MEMS scanning mirror," January 20, 2026, 2:00 PM - 2:20 PM PST

Patrick Engelmann: "CMOS-integrated optical quantum sensing platform based on NV-diamond technology," January 22, 2026, 10:55 AM - 11:10 AM PST

About OptoQuant:

The "OptoQuant" project is funded under the Fraunhofer-Max Planck cooperation program.

Project duration: January 1, 2024 – December 31, 2027

Project partners: Max Planck Institute for Chemical Physics of Solid States CPfS, Fraunhofer Institute for Photonic Microsystems IPMS

About Fraunhofer IPMS

The Fraunhofer IPMS is a leading international research and development service provider for electronic and photonic microsystems in the application fields of Intelligent Industrial Solutions, Medical Technology and Health, Mobility, Green and Sustainable Microelectronics, Aerospace, and Defense. The institute works on electronic, mechanical, and optical components and their integration into miniaturized devices and systems. The service range includes everything from concept development to product development and pilot manufacturing in its own laboratories and clean rooms.