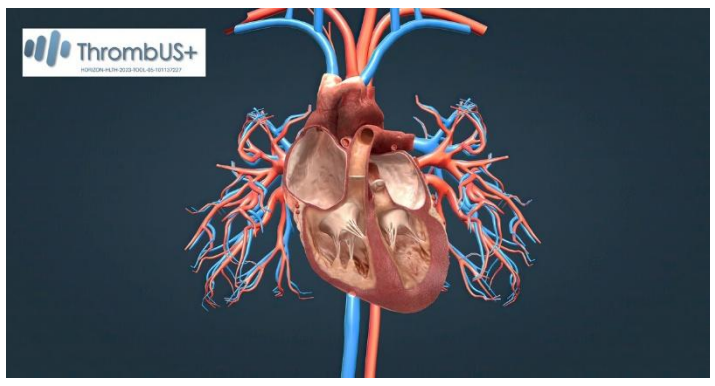
October 2025

TECHFLASH

We are pleased to introduce you to Fraunhofer TechFlash - Fraunhofer's Flash News on latest and exciting technologies.
This week's TechFlash is about **Diagnostics and Sensors for Bio and Health Applications.**

The **Fraunhofer Institute for Photonic Microsystems (IPMS)** is a worldwide leader in research and development services for electronic and photonic microsystems in the fields of Smart Industrial Solutions, Medical & Health applications and Mobility.

Diagnosis of Deep Vein Thrombosis (DVT)



Deep vein thrombosis (DVT) and its fatal complication, pulmonary embolism (PE), affect millions worldwide and account for a large share of hospital admissions. Nearly 50% of DVT cases lead to PE, of which 25% are fatal, making it the third leading cardiovascular cause of death after stroke and heart attack. With up to two-thirds of cases asymptomatic, diagnosis is highly challenging, underscoring the need for early detection to prevent life-threatening complications, reduce long-term risks such as post-thrombotic syndrome and recurrent DVT, improve treatment outcomes and lower healthcare costs.

Next generation ultrasound: Fraunhofer IPMS has developed the ultrasound transducer array for portable, continuous monitoring of deep vein thrombosis directly on-site. The focus is on CMUTs (Capacitive Micromachined Ultrasonic Transducers), MEMS-based ultrasound transducers, which are considered the next generation of medical ultrasound sensors.

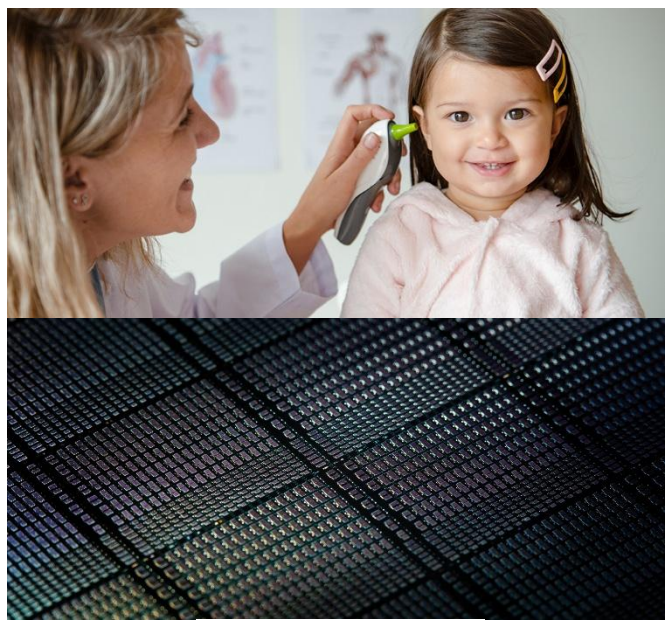
CMUTs offer several key advantages:
- Cost-effective large-scale production
- Miniaturization with a high number of channels
- Wide bandwidth combined with high sensitivity

These features enable the development of a completely new monitoring system for early diagnosis and therapy support of DVT.

We look forward to hearing of your interest.

Yes, I am interested

Quick Diagnosis of Middle-Ear Infections using Ultrasound



Wafer with CMUT chips

Middle ear infections, common in babies and young children, are often treated with antibiotics—yet outdated diagnostic tools lead to error rates of around 50%, especially in distinguishing bacterial from viral cases. This results in unnecessary antibiotic use and worsens global resistance. To address this, Fraunhofer IPMS has developed an innovative air-coupled ultrasound transducer, integrated into an otoscope, that delivers rapid, accurate diagnosis within seconds. It not only detects fluid behind the eardrum but also characterizes it, enabling precise differentiation of infection stages and more targeted treatment.

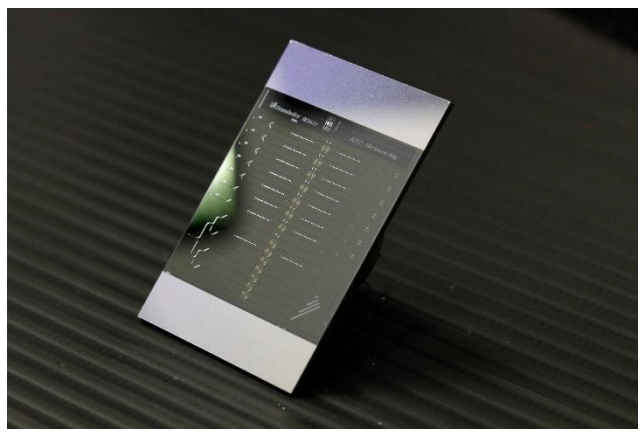
Advantages of CMUT Technology:
- Low power consumption
- Cost-effective mass production
- Miniaturization, enabling a very compact design
- Compared to conventional piezoelectric ultrasound transducers, CMUTs are significantly smaller and can be optimally integrated into otoscopes

This combination of precision, efficiency, and miniaturization makes the CMUT ultrasound transducer a promising solution for modern middle ear diagnostics.

We look forward to hearing of your interest.

Yes, I am interested

Marker-Free Detection with Photonic Biosensors



Photonics biosensor chip from Fraunhofer IPMS

Label-free detection methods, which enable molecular characterization without additional reagents, hold great potential for development. They allow for easy-to-use, rapid diagnostic tools that can be operated outside of laboratory settings, making them accessible to non-specialist users as well.

Innovative Solutions for Simple and Precise Diagnostics: Fraunhofer IPMS develops advanced photonic biosensors based on silicon nitride microring resonators fabricated with silicon technology. These sensors provide selective detection of biomarkers and microbial substances, offering a promising approach for early disease diagnosis.

Fraunhofer IPMS has developed a highly sensitive integrated photonic biosensor platform that aims to set new standards in diagnostic performance.

We look forward to hearing of your interest.

Yes, I am interested

Optical Oxygen Sensors for Versatile Gas Analysis

Texture background of bubbles in water

Measuring oxygen concentration precisely and flexibly is critical across industries such as medical diagnostics, environmental monitoring, and industrial process control. Fraunhofer IPMS has developed an advanced optical sensor platform that combines OLED-based excitation with CMOS-integrated photodiode arrays for real-time gas sensing, including oxygen detection.

The new integrated organic-CMOS sensor from Fraunhofer IPMS measures oxygen levels with high precision by exciting a phosphorescent dye using a blue OLED and capturing the emitted signal through photodiodes on a CMOS backplane. Oxygen concentration is then calculated via phosphorescence decay time along a calibration curve. This breakthrough combines Fraunhofer's decades of expertise in organic electronics, CMOS design, and sensor integration, enabling compact on-chip optical components and a versatile platform for diverse measurement tasks.

Fraunhofer IPMS's modular sensor architecture provides:
- Customizable measurement configurations
- High compatibility with off-the-shelf dyes and materials
- Miniaturized design for embedded systems
- Cost efficiency through CMOS-based manufacturing

We look forward to hearing of your interest.

Yes, I am interested

Microdisplays

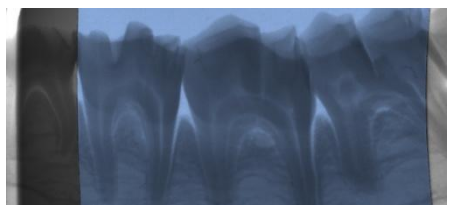
Smart glasses offer tremendous potential for medical technology, especially in minimally invasive surgery or complex procedures. Surgeons and physicians can view X-rays, CT scans, or real-time endoscopic images directly within their field of vision—without looking away from the patient. This allows for hands-free operation while keeping all critical information accessible, significantly enhancing surgical efficiency and patient safety.

Fraunhofer IPMS develops precisely these microdisplays, tailored for medical wearables and diagnostic tools. Fraunhofer IPMS is working on bidirectional microdisplays that combine display and image sensor on a single chip. This enables not only visual output but also eye movement tracking, allowing intelligent, hands-free control - a major step forward for smart surgical assistance systems.

We look forward to hearing of your interest.

Yes, I am interested

MEMS-Based Microscanners for Advanced Medical Applications



Digitize X-Ray dental film using MEMS scanning

Fraunhofer IPMS is pioneering the development of MEMS-based micro scanners for a wide range of medical imaging and diagnostic applications. These compact, high-precision components are enabling new levels of performance and miniaturization across various healthcare technologies. This makes them ideally suited for medical applications. Micro scanners developed by Fraunhofer IPMS are used in: (i) Medical endoscopy for high-resolution internal imaging (ii) Confocal and fluorescence microscopy (iii) Spectroscopy applications in life sciences (iv) Ophthalmological diagnostics and treatments.

One notable innovation is the institute's development of double-resonant MEMS scanners, which serve as the core technology in a compact X-ray film scanner used in digital dentistry. This breakthrough enables efficient digitization of dental radiographs with enhanced clarity and minimal hardware footprint. Fraunhofer IPMS collaborates closely with medical device manufacturers to bring MEMS micro scanners into clinical practice.

We look forward to hearing of your interest.

Yes, I am interested

Components and Modules for Improved Optical Point-of-Care Diagnostics

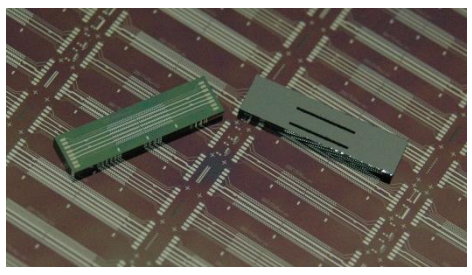
Lab-on-Chip (LOC) diagnostics is now a modern standard in various laboratory testing procedures. It enables automated and precise processing as well as evaluation of medical samples. Diagnostic results can thus be provided more cost-effectively, faster, and earlier than with conventional laboratory analyses. However, for some applications, suitable Lab-on-Chip systems do not yet exist. Therefore, Fraunhofer IPMS is developing innovative components and modules together with partners specifically for LOC diagnostics of cytokine release syndrome (CRS).

Fraunhofer IPMS has developed advanced biological assays combined with electronic, optical, and fluidic components to create a fully integrated Lab-on-Chip system for CRS diagnostics. Fraunhofer IPMS contributes the optical design for highly sensitive optical detection. The goal is to improve early detection of severe disease courses, utilize clinical resources more efficiently, and sustainably enhance medical care for patients.

We look forward to hearing of your interest.

Yes, I am interested

Compact gas sensing systems - Ion Mobility Spectrometer (IMS)



In the field of chemical sensors, Fraunhofer IPMS develops sensors for the detection of selected gases from the atmosphere. In the fields of environmental as well as biomedical analytics, there is an enormous demand for mobile devices that can detect specific substances in the ppm to sub ppb concentration range. Typical substances are, for example, from the group of volatile organic components (VOCs) such as acetone or toluene, which are of great importance in marker recognition or pollutant detection, for example.

Fraunhofer IPMS is therefore developing a modular component for trace gas analysis that can be used with customers and cooperation partners for application-specific product developments.

We look forward to hearing of your interest.

Yes, I am interested

Human health is a global priority and one of the key application areas of photonic microsystems at Fraunhofer IPMS. The technologies of Fraunhofer IPMS enable early disease detection, advanced diagnostics and targeted therapies, addressing the growing demands of an aging population and the rise of chronic diseases.
With our modern MEMS-based solutions, we support:

- Early diagnosis using high-resolution imaging techniques
- Detection of pathogens and ingredients in food, breath and body fluids

Fraunhofer IPMS combines miniaturization, precision, and integration, thus paving the way for next-generation medical technologies.

About Capacitive micromachined ultrasonic transducers (CMUT) Evaluation Kit:
The evaluation kit "CEK CMUT" offers interested developers of ultrasonic sensors and users the possibility to build up a fully functional test setup for the evaluation of miniaturized capacitive micromechanical ultrasonic transducers (CMUT). It consists of either one or two CMUT sensor modules, customized control electronics and software as a web application that controls the CMUT via plug-and-play.

Virtual Showrooms of Fraunhofer IPMS:
(Please click on the hyperlinks)

- **Ultrasound technology in our 3D showroom**
- **MEMS scanner technology in 3D showroom**
- **Spatial light modulators in our 3D showroom**

Videos:
(Please click on the hyperlinks)

- **MEMS-based laser scanning microscopy for improved cancer cell detection**
- **Structured Illumination for Microscopy**
- **How does our CMUT evaluation kit work?**

About Fraunhofer-Gesellschaft:
Founded in 1949, the Fraunhofer-Gesellschaft based in Germany is the world's leading applied research organization. It offers contract-based R&D services for specific industry demand, application-oriented technology development from proof-of-principle up to market-readiness across the value chain and offers technical consultancy and feasibility studies to nearly all the industry sectors. The Fraunhofer-Gesellschaft currently operates 75 institutes and research units throughout Germany. Over 32000 employees, predominantly scientists and engineers, work with an annual research budget of €3.6 billion. Fraunhofer generates €3.1 billion of this from contract research. Our global footprint is very strong, with offices and research centres in the USA, Europe and Asia. Some of our renowned innovations are the MP3 software, white LED's and the smallest of cameras. Fraunhofer has been a long-time trusted innovation partner in India, collaborating with some of the major players in the fields of Material Science, Energy, Environment, Automotive, Electro-mobility, Production Technology, Microelectronics and Smart Cities, working with Industry, Government and Public Sector.

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