PRESS RELEASE

Semiconductor manufacturing

Ferroelectric Memory - Fast, Energy-Efficient Data Storage

Energy efficiency, faster processing and permanent data storage: In collaboration with GlobalFoundries, research scientists at the Fraunhofer Institute for Photonic Microsystems IPMS have developed a novel storage technology that meets exactly these requirements. The team has succeeded in integrating hafnium oxide-based ultra-fast ferroelectric FRAM memory into an existing industrial manufacturing technology. They have been selected to receive the Stifterverband Science Prize *Forschung im Verbund* (Joint Research) for their efforts.

Digital systems are posing ever-increasing demands on memory: It must be fast, durable, non-volatile, and also extremely energy efficient. Current memory solutions are reaching their limits, especially in applications in the automotive sector, industrial automation and medical technology. Fraunhofer IPMS and GlobalFoundries have addressed this issue in a joint research project. Franz Müller, Maximilian Lederer, Nandakishor Yadav and Konrad Seidel, along with Sven Beyer and Robert Seidel, have developed a novel memory technology enabling energy-efficient electronics and new computing architectures.

Ferroelectric memory for permanent data storage

The research is centered around an FRAM (ferroelectric random-access memory) that uses ferroelectric hafnium oxide for permanent information storage. "In ferroelectric memory technology, ions are shifted very rapidly within a crystal lattice, resulting in a change in polarization. We can use exactly this effect to store information," explains Konrad Seidel, Head of the Emerging Memory Solutions business unit at Fraunhofer IPMS. The major advantage of this method is that the information is retained even without power and can be read as often as needed without loss.

Integration into industrial chip manufacturing

A key achievement of the project is integration of this memory into existing industrial manufacturing technology. The researchers have developed a reproducible approach for embedding ferroelectric FRAM cells in GlobalFoundries' 22FDX technology node. This platform is specifically designed for manufacturing ultra-low-power microchips. "It is a major milestone to be able to demonstrate that something you have been intensively researching can actually be manufactured on a large industrial scale," says Fraunhofer IPMS project lead Franz Müller. The novel memory cells operate at power-efficient operating voltages of less than one volt, switch within nanoseconds and

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exhibit a long cycle life, meaning they can reliably endure a high number of write and erase cycles.

The basis for edge AI and new applications

This new memory technology is especially relevant for applications that depend on energy efficiency, such as autonomous sensors, battery-powered systems or on-device artificial intelligence. "Our non-volatile memory technology has far lower power consumption than that of existing solutions. This enables the use of artificial intelligence not only in data centers but also directly in edge applications where data is processed locally on the device," explains Fraunhofer IPMS lead scientist Maximilian Lederer.

This progress is crucial from the perspective of industry. "Affordable ultra low power technology combined with an ideally matched memory solution is especially attractive for applications like edge AI. This represents the combination of two technologies that complement each other perfectly," emphasizes Sven Beyer from GlobalFoundries.

The success factor of joint research

The project builds on many years of close collaboration between Fraunhofer IPMS and GlobalFoundries at the Dresden location. The materials, processes, modules and manufacturing environment were developed in collaboration and were closely coordinated in the Silicon Saxony innovation ecosystem. "The open collaboration based on trust between industry and research provided the foundation for rapidly translating our innovation into a realistic application scenario," says Konrad Seidel. This technology, brought rapidly to market by joining forces, creates a key basis for high-performance, robust and energy-efficient next-generation electronic systems. This strengthens Germany's position in the highly competitive global market for semiconductor manufacturing technologies.

Stifterverband Science Prize

For more than 20 years, Stifterverband and Fraunhofer have been awarding this prize, which comes with 30,000 euros in prize money, on a biennial basis. This recognizes joint applied research projects of particular scientific excellence that Fraunhofer institutes are working on in collaboration with industry and/or other research organizations.

About Fraunhofer IPMS

Fraunhofer IPMS is a world-renowned research and development service provider specializing in electronic and photonic microsystems. Our technologies are used in industries such as mobility, biotechnology, and medical technology. We are also addressing key future fields, such as quantum technologies and neuromorphic computing. Through our research in green microelectronics, we contribute to a sustainable and resource-efficient world.
With the Center Nanoelectronic Technologies (CNT), Fraunhofer IPMS offers applied research on 300 mm wafers for microchip producers, suppliers, device manufacturers and R&D partners.

Images

Many years of close collaboration (from left): Sven Beyer (GlobalFoundries), Nandakishor Yadav, Franz Müller, Konrad Seidel and Maximilian Lederer (Fraunhofer IPMS)
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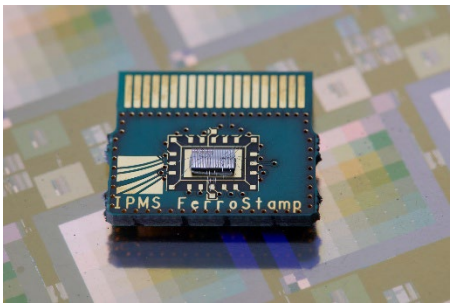

Energy efficiency, faster processing, and permanent data storage: The new memory technology meets all of these requirements
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