

News

Process modeling from atom to wafer: New high-performance computer system at Fraunhofer ENAS paves the way for a new generation of knowledge-based process models for semiconductor technology

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In June 2024, a new high-performance computer system with almost 2,000 computing cores in classic central processing units (CPUs) was presented to the research teams at Fraunhofer ENAS. The new supercomputer expands the institute's research infrastructure, thus enabling it to significantly increase the speed of complex computing operations for the modeling and simulation of semiconductor technologies via parallel computing.



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In the picture (from left to right): Andre Singer (CEO at MEGWARE) and Dr. Jörg Schuster (Head of the team "Simulation

The ultra-modern, high-performance computer allows Fraunhofer ENAS to massively shorten computing times for data-intensive digital modeling methods and simulation approaches that are used for the development of novel manufacturing processes in semiconductor and nanotechnology. One such complex and computationally intensive process is the calculation used to simulate flows in connection with chemical deposition reactions, such as those that can occur in semiconductor technology systems.

"Thanks to the new system, we can now perform such complex computing operations not only in parallel, but also much faster. This enables us to work with our customers to develop and optimize new semiconductor processes and systems, as well as innovative materials and devices for micro- and nanoelectronics, even more efficiently. This allows us to both react more flexibly to customer requests and save valuable time and costs," explains Dr. Jörg Schuster, head of the team "Simulation of Processes, Material and Devices" at Fraunhofer ENAS.

The new computer system provides additional computing capacity with its extremely powerful graphics cards, which are used to visualize simulation models. Special algorithms also use the graphics cards' enhanced computing power, thus allowing simulation models to be further accelerated.

In addition, the computer system is equipped with two AMD VCK5000

of Processes, Material and Devices" at Fraunhofer ENAS)



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In the picture (from left to right): Dr. Jan Langer (Head "Data-based Methods" at Fraunhofer ENAS), Dr. Jörg Schuster (Head of the team "Simulation of Processes, Material and Devices" at Fraunhofer ENAS) and Andre Singer (CEO at MEGWARE)

accelerator cards, which combines programmable circuits known as field-programmable gate arrays (FPGAs) with high-performance vector processor arrays. This heterogeneous computing hardware is specially tailored to the challenges of machine learning, sensor data fusion, and complex algorithms in semiconductor research. This benefits, among other things, innovative knowledge-based process models that use machine learning to combine expert knowledge, factory data, and data from physical and chemical models to create compact, predictive, and real-time-capable process models. The system is complemented by a high-performance network that enables internode parallel computing. It also features system management and, with 500 terabytes of hard disk storage, is equipped with an exceptionally high storage capacity.

Numerous process modeling projects with well-known semiconductor manufacturers will benefit from the new computer system at Fraunhofer ENAS. With equipment costs for semiconductor production constantly rising, making test runs on a factory scale increasingly expensive, powerful computing technology enables the virtual prototyping of semiconductor processes, their optimization for better device performance and higher yields, and the identification of completely new production approaches and nanodevices. The increasing miniaturization of semiconductor devices means that comprehensive modeling of materials and processes, from the atom to the wafer, is also essential. In addition to classic numerical models, simulation approaches from quantum physics are therefore becoming increasingly important.

The high-performance computer system was procured with funds from the central strategy fund of the Fraunhofer-Gesellschaft and Fraunhofer ENAS. With MEGWARE, one of Europe's leading supercomputing specialists, a Chemnitz-based company has been secured to supply the computer system and oversee its initial start-up.

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