KICK-OFF OF THE EUROPEAN PROJECT FOR
QUANTUM COMPUTING HARDWARE ECO-SYSTEM “MATQU”

MATQu enables stable European industry-scale fabrication value chains for solid-state-based quantum computer development

The (computational) performance of quantum computers relies heavily on their core hardware element: the qubit. Several approaches to realize qubits exist, yet they still lack stable scalable fabrication value chains to become industrially viable technologies. The project “MATQu” aims to expand the European expertise in materials and processes and enables the European industry to further develop solid-state-based quantum computers.

“MATQu - Materials for Quantum Computing”, led by the joint business office of the Fraunhofer Group for Microelectronics and the Research Fab Microelectronics Germany (GS VUE/FMD) as well as Fraunhofer IAF, started in June 2021 with the goal to support the creation of a pan-European research infrastructure for advanced computing technologies. The project brings together world-class European research and technology organizations, industrial fabrication facilities and leading application partners in the domain of solid-state qubits - a subject of intense global competition - to realize the vision of a European supply chain for materials and processes.

The project will create a European eco-system to expand the applicability of core components of solid-state qubits—such as Superconducting Josephson junctions (SJJs)—by improving materials, as well as processing and characterization technologies for quantum computing hardware. In the three-year project, SJJs are the primary use case as they are currently the most mature solid-state platform to realize stable superconducting qubits.

Bringing superconducting qubits to market

Superconducting qubits are among the most promising components to realize a large-scale quantum computer. The relatively rapid success of Josephson junction-based qubits can be attributed to design principles that are based on well-established production processes. The performance of SJJs, however, depends critically on the quality of the fabrication substrates, the materials used to make the circuit components, as well as the reproducibility of the processes applied in fabrication. A stable and controlled value chain is key to improving these parameters in the future.

The main technical goal of the project “MATQu” is to improve and transfer materials and technologies for superconducting qubits from laboratories to the market. Several project partners have extensive infrastructures suited for this purpose and will contribute with their expertise in materials, process integration, and research to build robust and reproducible qubits. Industry-style fabrication infrastructures will allow optimizing process parameters and systematically improving the performance of superconducting qubits.

Reducing the variability of qubits

Often, qubits are described as having a mind of their own, which is to say that very large device-to-device variability is measured. Complex methods to tune qubits are required to control the variability. This, in turn, adds to the complexity of quantum computer architectures compared to traditional (von Neumann) computer architectures. It is one of the main limiting factors for scaling the number of qubits in quantum computers today.

“MATQu” aims to reduce this variability among qubit components. Researchers will investigate the impact on device variability of all material parameters and process steps. For this purpose, the consortium will gather broad knowledge and experience with developing process steps and designing experiments that allow reducing the impact of specific process parameters on device performance. “While we do not expect the same integration level as classical computer chips for the next 5 to 10 years, we will certainly take a big step towards variability reduction in superconducting qubits,” explains Prof. Rüdiger Quay, project coordinator from Fraunhofer IAF.

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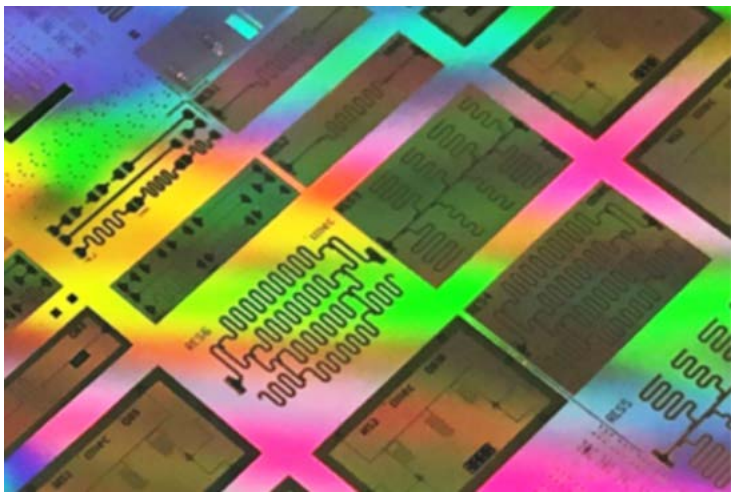
Concerning substrate technology, process technology and tools, MATQu brings together major European actors in the field, including four large RTOs. The 18 MATQu partners complement each other in an optimal manner across the value chain to create a substantial competitive advantage, e.g., faster time-to-market and roll-out of technologies and materials for better qubits for quantum computing.

Please visit the project website www.matqu.eu for more information.



Test chip with superconducting qubits in a 300 mm integrated process prototype (© IMEC)

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About kiutra

Kiutra is the Munich-based specialist offering rapid testing tools, services, and integrated platforms for cryogen-free sub-Kelvin cooling. Our products facilitate low-temperature investigations and accelerate the development and testing of quantum hardware, thus supporting breakthrough science and the adoption of quantum technologies at an industrial scale.

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