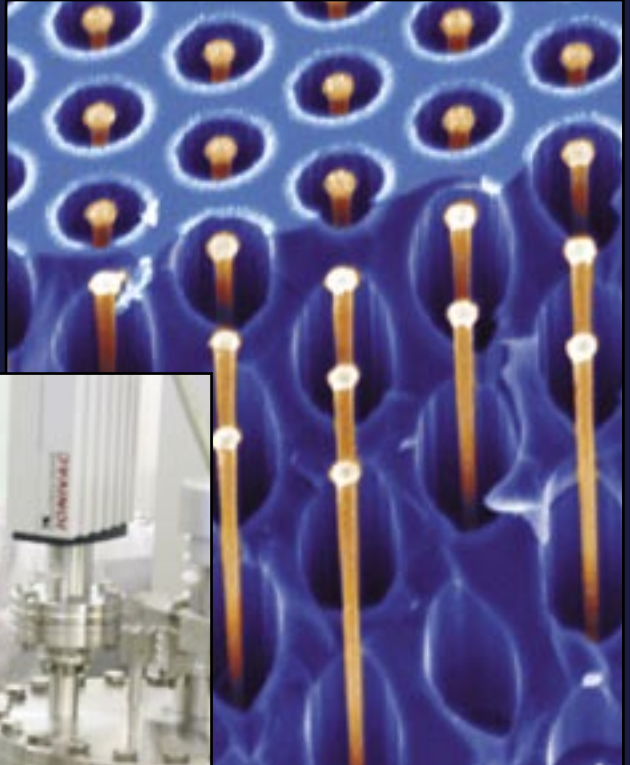


CHALMERS

The Process Laboratory at Chalmers

Your partner in micro and nano fabrication

**State-of-the-art
Professional
Responsive
Stimulating
Innovative**



Microtechnology and Nanoscience

MC2

Three partnership options



Research Collaboration

- Partner with leading researchers from across Chalmers University of Technology
- Innovative R&D solutions for industry & academia
- Responsive to our partners' needs

Contact:

Head of Department

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+46 31 772 1881



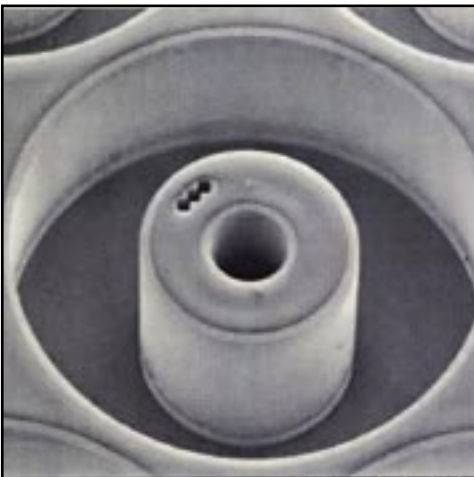
Cleanroom Access

- Your own employees access our state-of-the-art research laboratory
- Creative & innovative environment
- Education & training available

Contact:

Head of Process Laboratory

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+46 31 772 4983



Processing, Prototypes & Consultancy

- Professional, confidential, and expert cleanroom engineering staff
- Fabrication according to your specs
- Process development to meet the functionality you require

Contact:

External Processing Coordinator

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Which fit is best for you?

Research Collaboration

Research partnerships between Chalmers and external organizations allow for the closest collaboration and the greatest potential innovation and value. Research projects are typically long term with the aim of exploring and developing new technologies. Cleanroom processing in combination with strong theoretical support in close cooperation with the partner organization results in breakthrough technologies. Research groups at Chalmers have unique expertise in the physics & technology of materials, devices, and circuits for micro and nano systems. Detailed information on the research carried out at MC2 can be found in the department's Annual Report.

Philips Semiconductor is one example of an organization which has entered a research partnership with Chalmers. Philips transferred its SiC process research from its own research centre to the Microwave Electronics Laboratory at Chalmers to investigate the potential of SiC MOSFETs for RF applications. This collaboration has resulted in MC2 producing MOSFETs with world record mobility in the inversion channel. The project was recently extended to investigate the manufacturability of these devices while further developing the technology.

Cleanroom Access

The Process Laboratory hosted employees from 11 different industrial partners in 2004. After completing the mandatory Cleanroom Introduction Course and receiving the necessary training on the desired process tools, our partners' employees have equal access to the Laboratory as our own researchers and engineers. Access to a state-of-the-art laboratory can be thus realized without the prohibitive capital investment required to begin such operations, or can serve as a backup to our partners' own facilities. In addition, the Laboratory provides a creative environment where lab users work together to solve processing problems.

One example of a partner with Cleanroom Access is Midorion AB, an innovative company developing and marketing analytical biosensor systems for life science applications. The firm uses MEMS technology to measure quantum electrical phenomena in real time through changes in electric fields. A number of employees have access to the Process Laboratory and carry out both production and R&D in close partnership with researchers at Chalmers.

Processing, Prototypes & Consultancy

Processing, prototype fabrication, and consultancy services are provided professionally and confidentially by the Process Laboratory's own full time engineering staff. These projects are typically of shorter time frame than research collaborations, and can range anywhere from cleanroom processing according to specs given by the partner to developing a whole process flow in the cleanroom.

Chalmers' vast competence within nanolithography is a particularly popular service. Examples of projects carried out with our partners include the fabrication of diffractive optical element masters and direct write patterning. Thin film deposition of oxides, nitrides or metals is another common service the Laboratory provides, often in combination with photolithography and/or plasma processing.

The Process Laboratory and its Strategic Focus Areas

The Process Laboratory at MC2

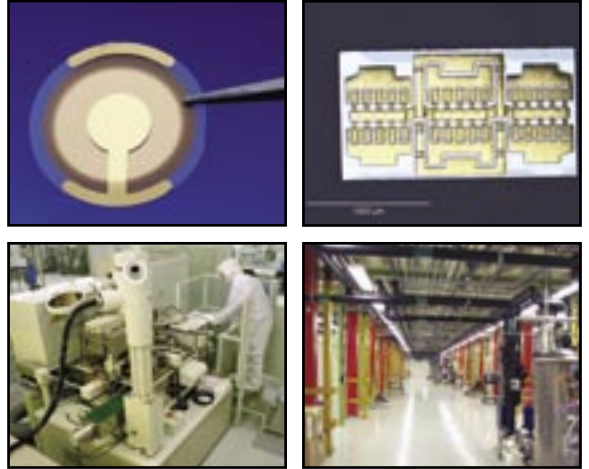
The Process Laboratory is a world-class university cleanroom for research into and fabrication of micro and nanotechnology. It is managed by the Department of Microtechnology and Nanoscience (MC2) at Chalmers, but is an open facility for the entire university as well as external academic and commercial interests.

Cleanroom operation in its current form was started in 2001. The Laboratory is a state-of-the-art facility with 1240 m² of cleanroom classified area with process and measurement tools providing a broad platform for the development and testing of new ideas in micro and nano technology. The Laboratory is also a member of μ -Fab, the Swedish micro and nano fabrication network supported by The Swedish research council, SSF, Vinnova and Knut and Alice Wallenberg Foundation. This gives access to a larger infrastructure through the Microstructure Laboratory at Uppsala University and the Electrum Laboratory at KTH in Stockholm.

MC2's two strategic focus areas have recently resulted in the launch of two processing lines in the Laboratory to complement the flexible processing and materials environment. The lines increase the quality, throughput, and stability of the microwave & nano/quantum devices and components fabricated in the Laboratory.

Strategic Focus Area #1: Microwave & Photonic Processing Line

The microwave and photonic processing line consists of a complete set of process tools for the fabrication of microwave and photonic devices and components. Process tools which make up the line are either strictly limited to microwave/photonic devices, or have a limited number of approved processes which have been demonstrated to not have any adverse



Clockwise from top left: Q-sensor, Silicon Carbide MESFET, Media Basement, Ebeam lithography

effects on microwave/photonic processing. The line has resulted in improved stability, quality, and yield in the complicated process flows used in wide bandgap, low-noise, photonic, and terahertz devices. These are finding use in, for example, space applications for projects run through the European Space Agency. The materials processed on this line are predominantly SiC, GaN, and InP based MMICs as well as GaAs based VCSELs.

Strategic Focus Area #2: Nano & Quantum Technology Line

The nano & quantum technology line serves to increase the Laboratory's ability to produce state-of-the-art superconducting and quantum devices and novel nano components in higher yield. The line is anchored around Chalmers' long history and competence within electron beam lithography. Particular focus is being laid on attaining high yield on structures smaller than 20nm. With research and development in nanotechnology booming, this process line positions Chalmers to continue to be innovative for years to come. A very broad range of applications is served by this line, from bioelectronics to single electron devices.

Processing & Education

Electron Beam Lithography

Chalmers and MC2 have many years of experience and are extremely competent in the use of electron beam lithography. Chalmers is the clear leader in EBL in Scandinavia. Currently two JEOL systems are in operation in the cleanroom, including a JBX 9300FS currently writing features down to 8 nm. EBL is one of the most popular processing services that the Process Laboratory provides to commercial and academic clients, patterning a wide variety of substrates for diverse applications.

Thin Film Deposition

A wide variety of metal and insulating thin films can be deposited by a number of evaporation and sputter systems. A brand new FHR 150 mm sputter deposition system with 6 targets along with a Lesker Spectros e-beam evaporation system with 8 sources were installed in the Laboratory during 2004.

Plasma Processing

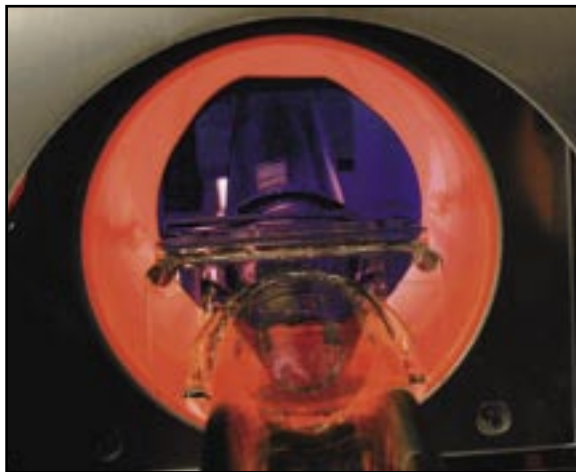
The Laboratory has a wide assortment of plasma tools for dry etching and deposition.

Thermal Processing

Chalmers has the ability to thermally process Si wafers up to 150 mm in diameter in its 4 four-stack Centrotherm E2000 furnaces capable of LPCVD, oxidation, drive-in, and annealing.

MBE of III-V materials

An EPI 930 MBE system is used in the Laboratory predominantly to grow III-V based heterostructures for microwave device applications. The following material combinations are possible: Ga, Al, In / N, P, As



Drive-in diffusion of Si wafers.

Education & Training

Education is a further function of the Process Laboratory. In its simplest form, hands-on training on the use of process tools is given by the staff. Classroom instruction is also given first in the form of The Cleanroom Introduction Course, which is a pre-requisite for all those who wish to access to Laboratory as a user. This covers such areas as safety, handling chemicals, proper cleanroom behaviour, and specific information concerning the Process Laboratory. The course is offered on a monthly basis, and at additional times if the demand is sufficient.

A graduate course in micro and nano processing technologies is also offered by the Laboratory. This gives a theoretical introduction to the common processes used in a cleanroom environment.

With its considerable competence and experience in education, courses can be customized to suit any partner's needs or interests.



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