

Institut für Mikroelektronik Stuttgart



Integrated Photonics Manufacturing at IMS CHIPS: Silicon, Silicon Nitride, and Thin-Film Lithium Niobate

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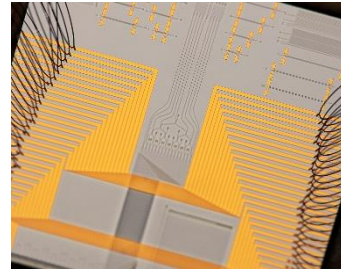
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Foundation under civil law

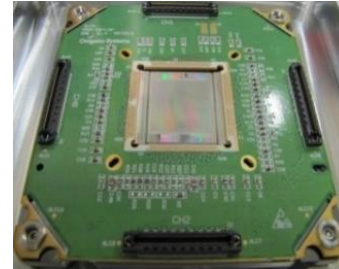
- Clean room 1200 m², class ISO4
- Research, development & production for SMEs and large corporations
- Scientific collaboration with universities & research facilities



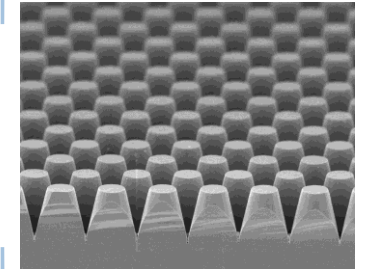
Integrated Circuits
and Systems



Silicon Photonics



M(E)MS Technology



Nanopatterning

	Silicon-on-Insulator	Silicon Nitride	Lithium Niobate
Transparency window	1100 – 8000 nm (mostly used around 1310, 1550 nm)	450 – 8000 nm	320 – 5600 nm
Integration density	Very high	Medium	Medium
Waveguide loss	Medium	Low, high-power handling	Low
Switching options	Fast & lossy or slow & low-loss (thermal)	Thermal, very inefficient	Fast & low-loss (electro- optic)
Non-linearities	$\chi^{(3)}$ (SFWM)	$\chi^{(3)}$	$\chi^{(2)}$, can be poled
Quantum applications	Photonic QC, QKD	Quantum Sensing, Photonic QC, QKD	Photonic QC, QKC, Quantum Memory (via rare-earth doping), Quantum Repeaters, ...



Vistec SB4050 & 255 Shaped Beam



Canon Stepper FPA3000



HIMT Laser ULTRA

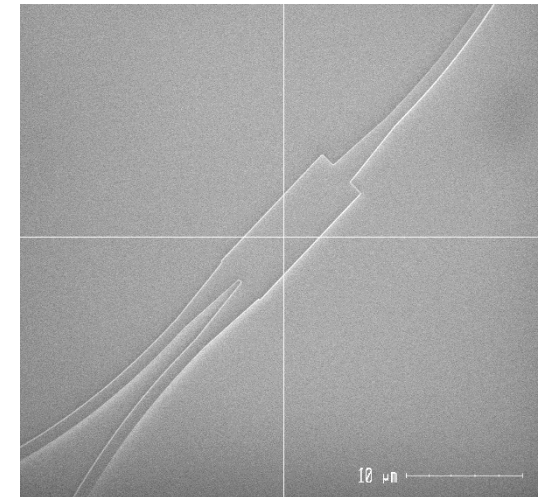
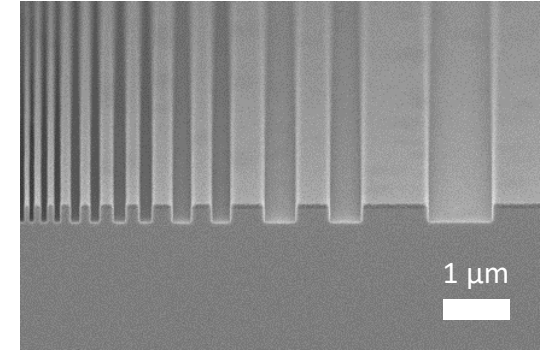
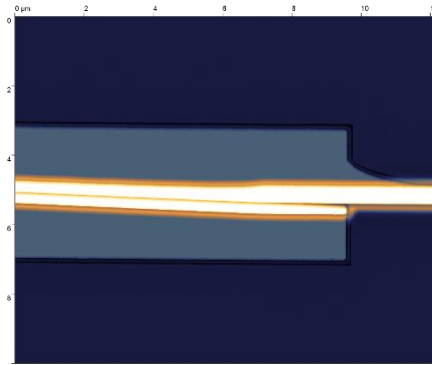
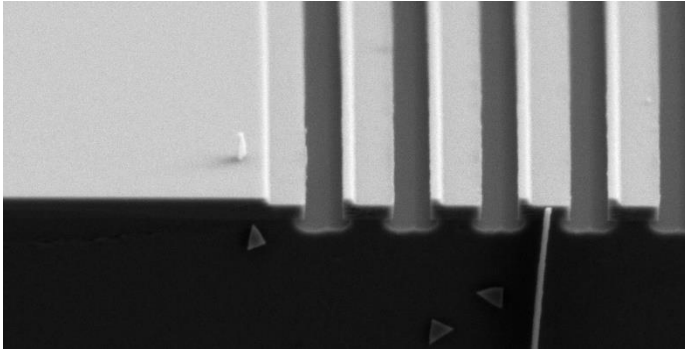


HIMT Laser VPG400

High-resolution waveguide patterning:
Variable-shaped electron-beam lithography,
50 keV, up to $1.6 \times 1.6 \mu\text{m}^2$ ($2 \times 2 \mu\text{m}^2$) shots

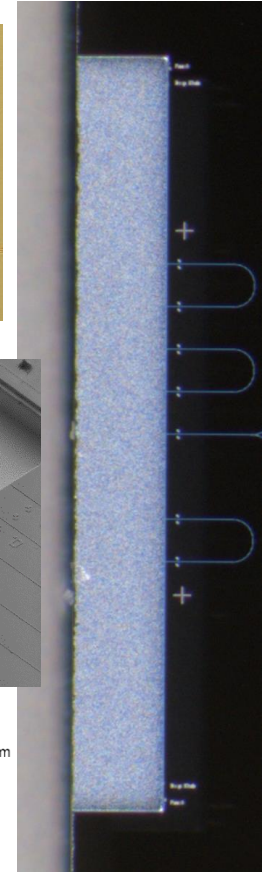
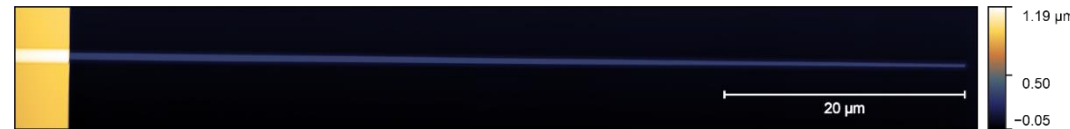
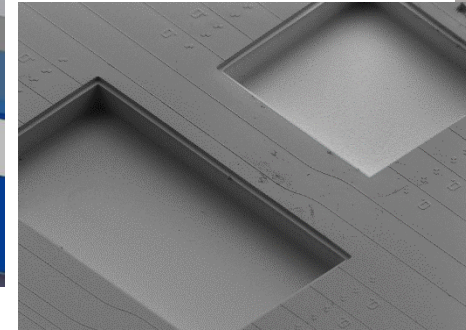
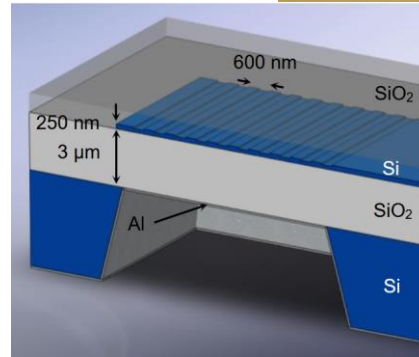
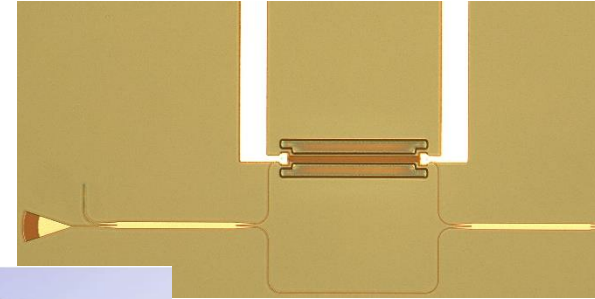
Back-End and add-on patterning:
i-line stepper lithography and
laser direct writing

➔ Intense use of direct writing, tailored to flexible full-wafer layouts

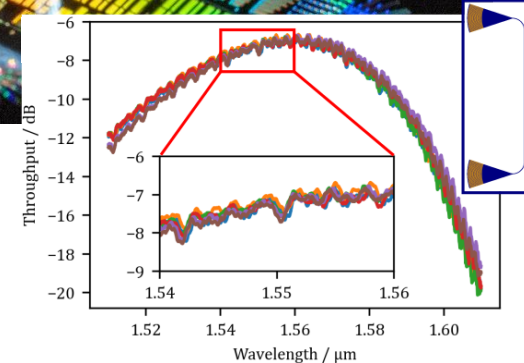
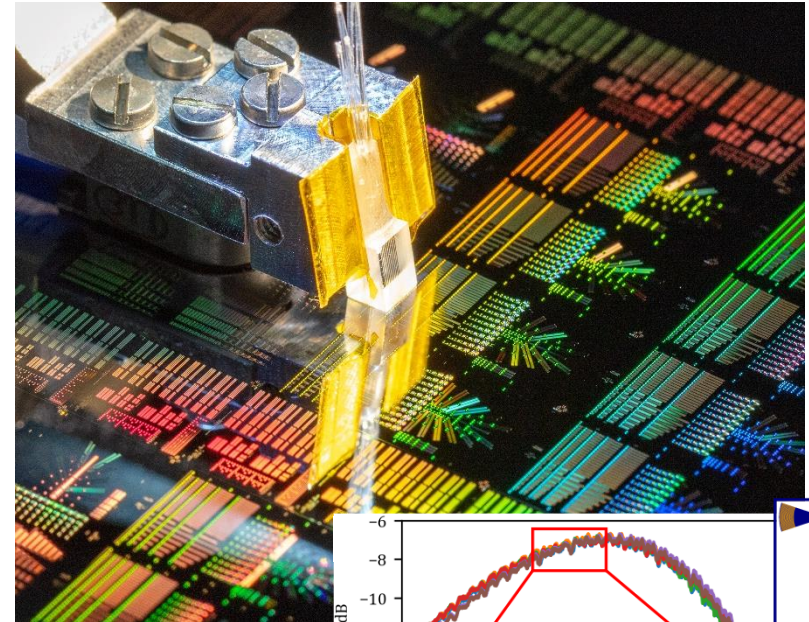
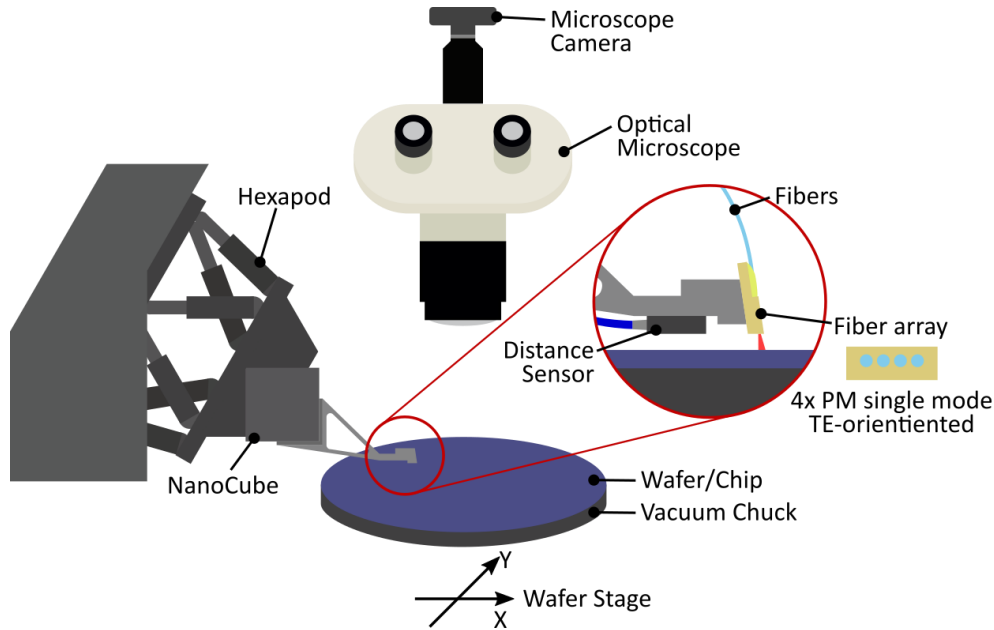


- Waveguide patterning, minimum feature size 70 nm (SOI)
- Shallow etches (fully custom depths)
- Silicon: dopant implantation

- Metallization (up to three layers)
- TiN heaters
- Selective cladding removal
- Suspended waveguides
- Isolation trenches
- Etched coupling facets
- Deep etches
- Backside mirrors
- ...



Optical Flying Probe Tester



Key objectives:

- High reproducibility: coupling loss uncertainty within ± 0.25 dB
- High speed: 800 to 1000 optical spectra per hour (passive only)

SOI and SiN platform:

- Custom technology stack: you only pay for processes that you need
- Mask-less direct writing: ideal for research, prototyping, and small-scale production, affordable at wafer-scale
- Delivery of full wafer or diced chips

Thin-film lithium niobate (start 2026):

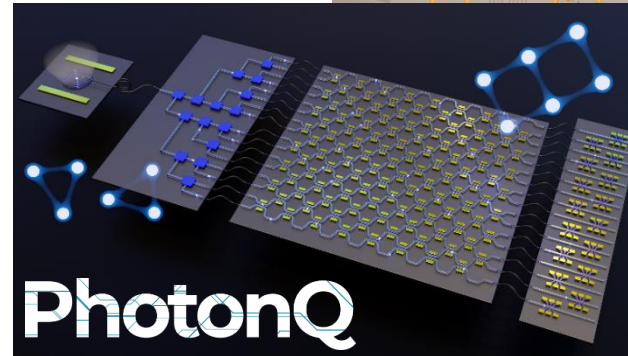
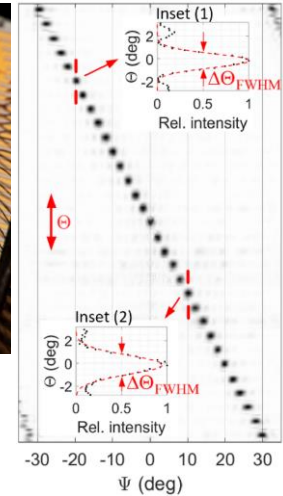
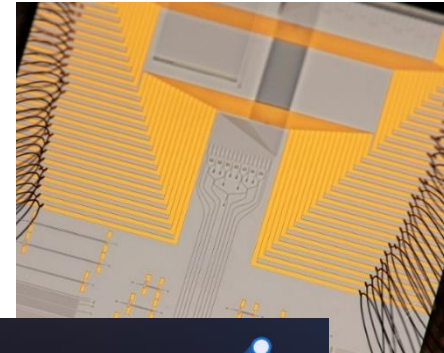
- Will provide a PDK to academic users for standardized multi-project runs
- Tailored to quantum applications

Supplementary Portfolio:

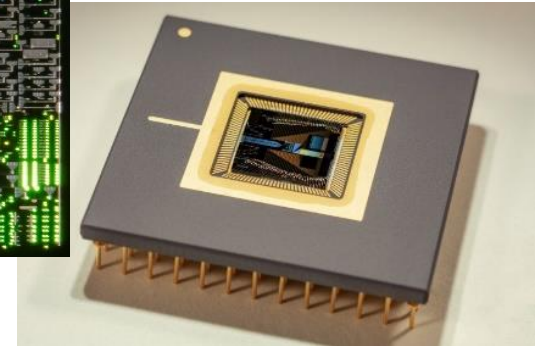
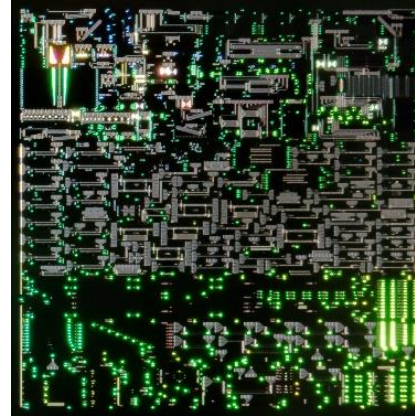
- Design & simulation services
- SiGe detectors (SPADs, APD)
- ASIC development
- Diffractive optical elements (single- or multi-layer), computer generated holograms on chip- or wafer-scale
- Mastering services e.g. for nano-imprint lithography
- MEMS processes

With partners in industry and academia:

- OPALID: Beam-steering chips for LIDAR
- PhotonQ: photonic quantum computing platform based on SOI
- LichtBriQ: development of quantum optic building blocks on LNOI
- QSens: miniaturization of quantum magnetometers based on diamond and SiC
 - Opportunity for German SME: Quanten4KMU platform



Thank you for your attention!



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