SAL
SILICON AUSTRIA LABS

Microsystems

Novel solutions for MEMS devices.

The Microsystems Research Division aims to develop beyond state-of-the-art technologies for novel MEMS devices. In close collaboration with our industrial and scientific partners we develop cutting-edge technology from design and proof-of-concept to product prototypes. In addition to our long-standing experience in MEMS, the Microsystems Division also relies on cross-border and interdisciplinary skills. These capabilities enable the team to push the boundaries of current technologies, promoting innovative and groundbreaking ideas in various directions and for diverse applications, with a strong focus on partners' and markets' interests.

"Microsystems make products not only smaller and more powerful, but also more efficient, smarter & multifunctional. In the Microsystems Division, we create the basis for novel technologies and processes on the verge of market trends and at the highest global level. With our expertise in MEMS design, modelling, microfabrication and characterization, we support our partners in strengthening their products and accelerate innovation."
Mohssen Moridi, Head of Division Microsystems

Our Service Portfolio:

Thin Film Technologies

Deposition

- Physical and chemical vapor deposition of thin film/stacks for piezoelectric, photonic, magnetic, and other applications
- Up to 200 mm wafers in ISO 5 infrastructure
- **Examples:** high quality piezo stacks for piezoMEMS; novel PECVD process for low density materials; new material compositions by co-sputtering; enhanced grain size metals by HiPIMS

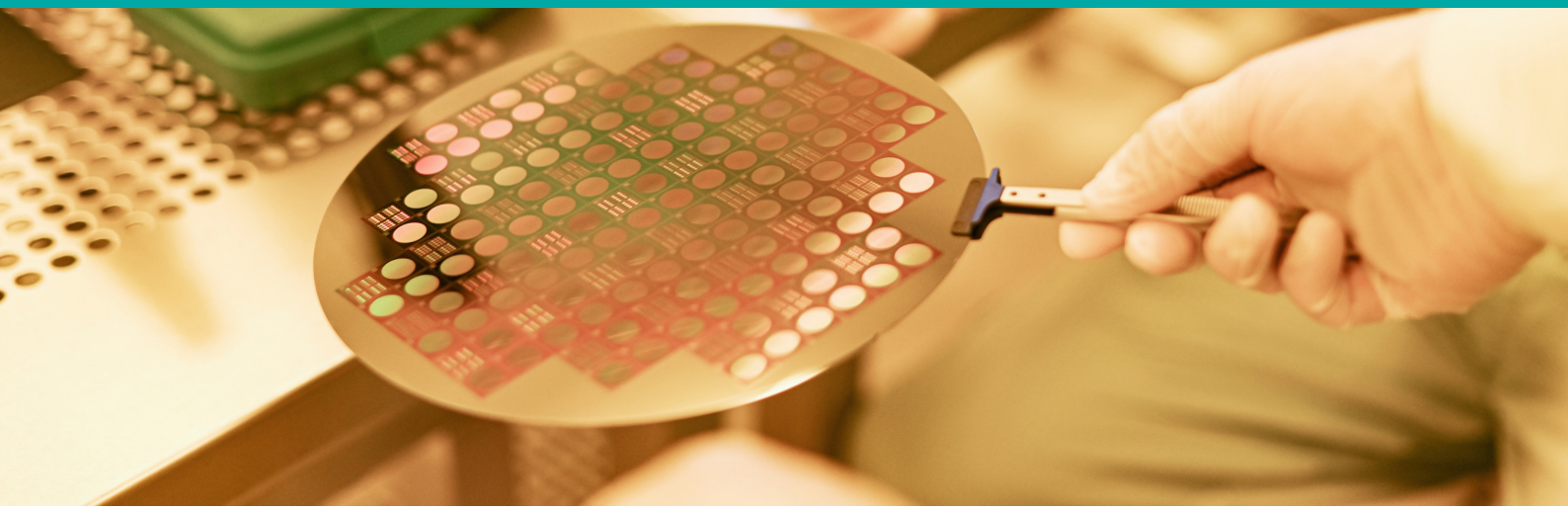
Characterization & Testing

- Understanding the structure of thin films and surfaces from atomic to macroscopic scale
- Techniques for obtaining material properties such as dielectric function, crystallinity, stress, roughness and many more
- Non-atmospheric and mapping possibilities for many tools
- **Examples:** mimicking annealing processes with hot stage environment; surface analysis of process steps; mapping of crystallinity, thickness, refractive index
- Testing of application relevant properties such as the piezoelectric coefficient
- Device test structures to test the thin films in action
- **Examples:** measurement of piezoelectric properties; cyclic testing

Key Equipment

- Magnetron sputtering – Evatec Clusterline 200E: 2 multisource modules for oxides/ nitrides (+ HiPIMS generator), PZT module, single target nitride module with hot chuck, soft etch module, PEALD (2023)
- Plasma-enhanced chemical vapor deposition – Oxford Instruments PlasmaPro 100
- Evaporation – Leybold Univex 900
- Rapid Thermal Annealing – Jivelec Jetfirst 200C
- X-ray diffraction and reflectivity – Panalytical MRD XL + Anton Paar domed hotstage
- Spectroscopic Ellipsometry – Semilab SE-2000IR + heating stage
- Atomic Force Microscopy – Park Systems NX20
- Resistivity Mapping – Filmetrics R50
- Stress measurement – Toho FLX-2320
- Double-beam laser interferometry – aixACCT aixDBLI with TF2000 for piezo testing; sample holders for thin film and bulk samples
- Raman microscope – Renishaw Qontor

Our Service Portfolio:



Integrated Photonics Technologies

Design & Simulation

- Photonic integrated circuits (PICs)
  - Passive and active integrated photonic components and systems for sensing and datacom applications.
  - Definition and optimization of photonic platforms based on various materials (Si, SiN, LN, AlN, plasmonic and emergent materials)
- Nano-optics and meta-optics
  - Nano- and micro-optics, optical antennas, metasurfaces, photonic crystals from components to systems.
  - Theory and concepts for meta-optics, non-classical optics and quantum-optics devices
- Multi-physics and advanced simulations
  - Nano- and micro-opto-electro-mechanical systems (MOEMS), nano-photo-thermal systems.
  - Inverse photonic design

Key Equipment

- CM300xi-SiPh 300-mm-wafer probe for PIC characterizations
- Santec 1500-1600 nm tunable laser and multi-port power meter
- A PIC testbed compatible with DC electro-optical testing with vacuum sample holder and active temperature controller

SOFTWARE

- Ansys Lumerical (FDTD, MODE): comprehensive component design
- Comsol: simulations requiring multi-physics
- Luceda IPKISS: complex circuit layout and modelling.
- Synopsis' RSoft (FullWAVE FDTD, RCWA, BandSOLVE, …)
- Matlab and Python: customized simulations and postprocessing

Measurement, Characterization & Testing

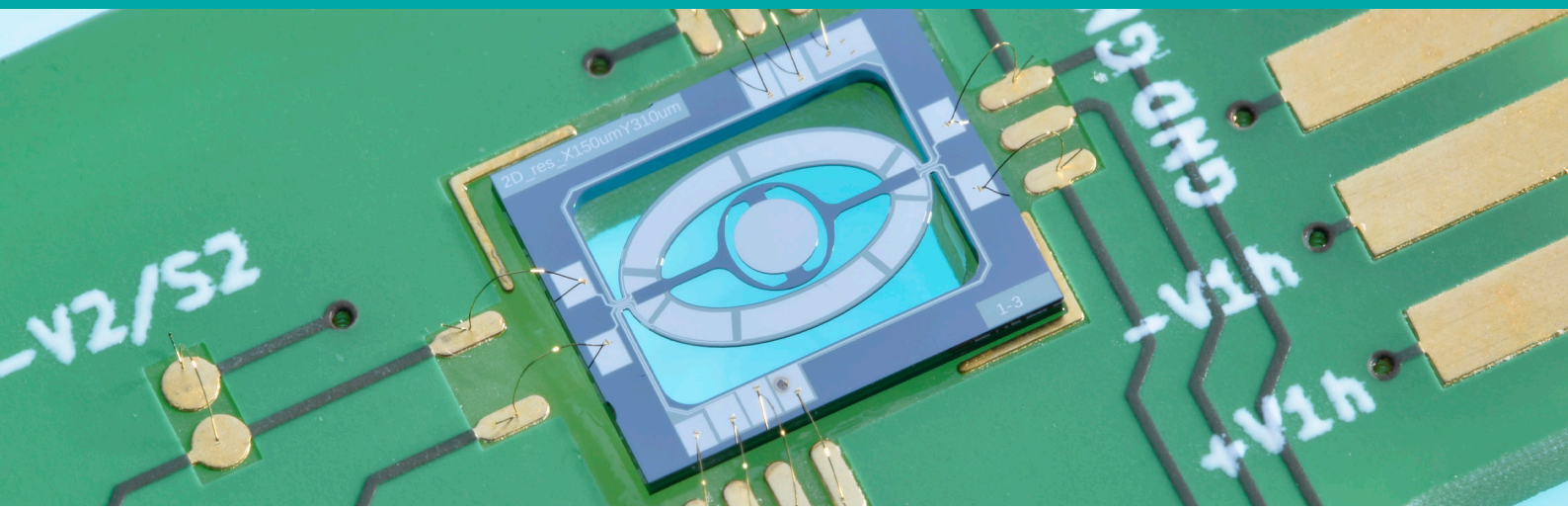
ISO-7 cleanroom-based photonics lab for characterization and demonstration.

- Photonic integrated circuits
  - Sample testing: horizontal & vertical alignment, C+L band covered, component performance (loss and bandwidth), electro-optical characteristics, complete circuit characterization
  - Wafer testing: automated testing and characterization by customizable routines, wafer size up to 12", NIR and MIR available
  - Lab-based environmental (gas) sensing and monitoring systems.
- Opto-electronics, opto-mechanics, thermo-optics characterization
  - Opto-electronics sensors, thermal sensors and bolometers
  - Optical emission spectroscopy and plasma diagnostics

Fabrication

- Photonic integrated circuits
  - Passive components based on SiNOI, SOI, Al(Sc)NOI platforms.
  - Post-processing of active components.
- Wafer-level optics, meta-optics, photonic MEMS
  - Low-loss optical thin-films and optical filters (oxides, nitrides, carbides, … and plasmonics).
  - Molding and nanoimprint technologies for wafer-level optics (microlens, metalens, freeform optics), metasurfaces.

Our Service Portfolio:



Piezoelectric Microsystem Technologies

Design & Simulation

- Design of piezoelectric MEMS such as piezoelectric MEMS microphone, PMUT, piezoelectric micromirror,SAW and BAW
- Simulations of MEMS devices at the die, package, system levels using methods including FEM, LEM, and analytical calculations
- Co-design and co-simulation of MEMS and IC or electronics for system-level optimization
- Process flow design and optimization taking into account our microfabrication platform capabilities

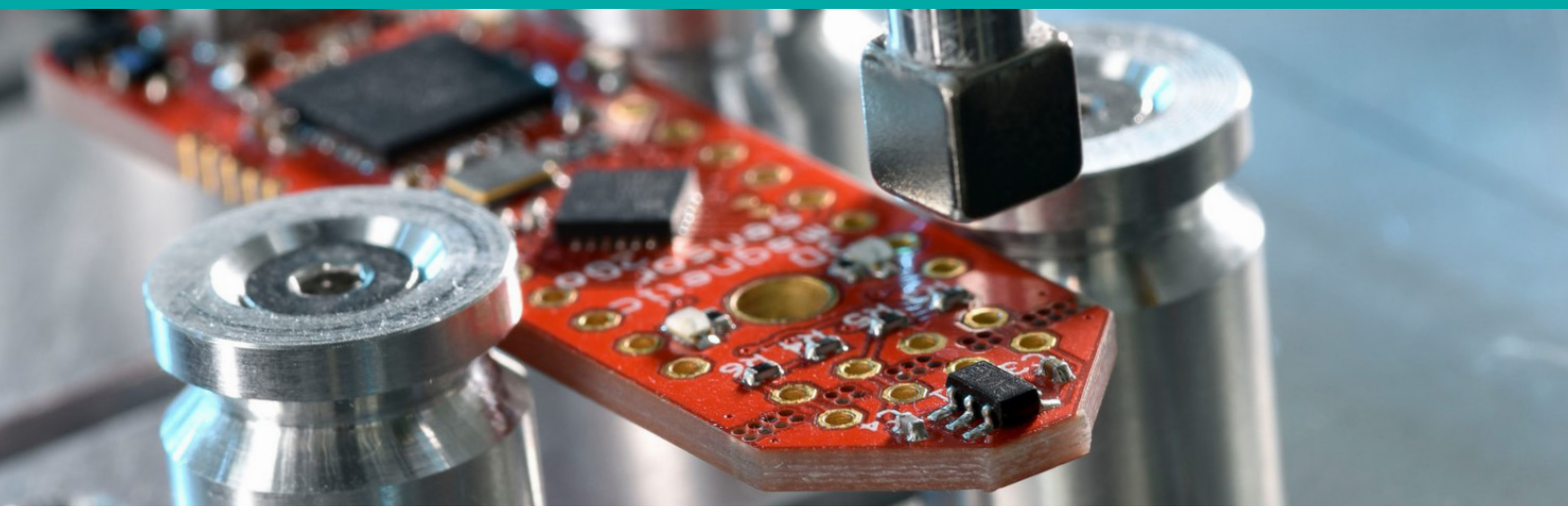
Measurement, Characterization & Testing

- Acoustic Lab (Wind Tunnel, Anechoic chamber, Impedance Analyses)
- Mechanical MEMS characterization (White Light Interferometry, Digital Holographic Microscopy, Laser Doppler Vibrometry)
- Characterization bench for optical scan angle of micromirrors
- Characterization of piezoelectric materials at the wafer level (polarization curve, piezoelectric coefficients, leakage current, dielectric losses)

Key Equipment

- Thin film deposition
  - Magnetron sputtering and co-sputtering: Evatec Clusterline 200 II
  - E-beam Evaporation: Leybold Univex 9000
  - PECVD: Oxford Plasmatherm
- Lithography
  - Mask Aligner: EVG 610
  - Direct Laser Lithography: Heidelberg DWL 66+, EVG Lithoscale
  - NanoImprint Lithography: EVG 7300
- Dry Etching / Wet etching:
  - Ion Beam Etching: Veeco
  - ICP-RIE: Oxford Cobra
  - RIE dedicated to Bosh process: Oxford Cobra
  - HF Vapor: SPTS
- Metrology:
  - SEM, EDX, XRD, AFM, Resisitivity, Stress

Our Service Portfolio:



Magnetic Microsystem Technologies

Magnetic Microsystems and MEMS

- Deposition and patterning of magnetic thin film materials for the microfabrication of magnetic sensors
- Design of magnetic sensors for custom applications via micromagnetic simulations
- Characterization and testing of micromagnetic sensor devices
- Integration of magnetic parts into MEMS devices and structures

Magnetic position and orientation systems

- Custom magnetic position system development for automotive and industrial applications fulfilling respective norms and standards
- High-end system simulations (magnetic field, magnetic position, current, magnetization process, stray fields, sensor simulations, tolerances …) with standard tools (ANSYS, COMSOL) and custom environments
- Magnetic position system construction, testing and prototyping

Key Equipment

- Thin Film deposition (Sputtering, E-beam evaporation), Patterning (Mask aligner, Laser lithography, E-beam lithography), Etching (wet, dry), Metrology (SEM, EDX, XRD, AFM, MFM)
- Industrial simulation environments (ANSYS, COMSOL) and custom simulation tools for magnetic position systems.
- Custom testbenches for magnetic position systems

Our Service Portfolio:

Heterogeneous Integration Technologies

Package Design and Multi-Domain Simulation

- Multi-domain Simulation (ANSYS Tools, ANSYS Twinbuilder)
- Evaluation of thermal stress
- Evaluation of coupled electric, thermal, thermomechanical behavior in packages
- FEM and Reduced Order Models
- Computational Fluid Dynamics Simulations

Heterogeneous Integration Technologies

- Waferlevel Packages (MEMS Encapsulation, W2W/C2W Bonding)
- Interconnect Technologies (Adhesive, Solder, Sinterpaste, Thermocompression, various material systems)
- Applicative Packaging development for MEMS, sensor, flexible/ sustainable electronics, power device, optical assembly …

Measurement, Characterization & Testing

- Shear/pull testing
- Nanoindentation
- Surface acoustic microscopy
- Functional, lifetime, aging and reliability testing
- In-situ characterization of devices at wide temperature range (-180 °C – +1000°C)
- Cross-section analysis
- Shear and dynamic bending test
- Scanning Acoustic Microscopy
- Helium leakage test
- Infrared Inspection of bonded wafers

Key Equipment

- Waferbonder EVG 520
- Waferaligner SmartView
- Finetec Lambda, Sigma
- Häcker Ourplant D1
- Manual wirebonders for thin wire and thick wire
- Bruker TI Premier Nanoindenter
- EVG 120 Infrared Inspection
- DAGE Optima+ Shear/Pull tester

ABOUT SAL

Silicon Austria Labs (SAL) is a top European research center for Electronics and Software Based Systems (ESBS). The application-oriented center offers cooperative research & services at three locations – Graz, Linz and Villach – in the pioneering research areas of Sensor Systems, Microsystems, Intelligent Wireless Systems, Power Electronics and Embedded Systems.

CONTACT

Lisa Kainz
+43 664 8896 4965
lisa.kainz@silicon-austria.com
www.silicon-austria-labs.com

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie
FFG
Das Land Steiermark
SFG NEUES DENKEN. NEUES FÖRDERN.
LAND KÄRNTEN
Partner of UAR INNOVATION NETWORK
oberösterreich