SAL
SILICON AUSTRIA LABS

VALIDATION LAB @SAL FOR PHOTONIC PACKAGING AGEING EVALUATION

ALI ROSHANGHIAS, ANDREU LLOBERA & RUDOLF HEER

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

FFG

Das Land Steiermark

SFG

LAND KÄRNTEN

ober österreich

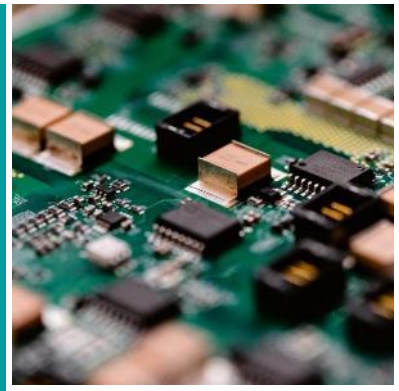
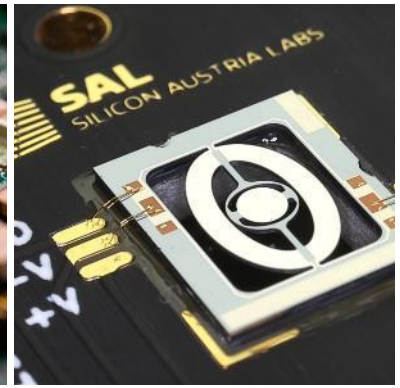
Member of UAR INNOVATION NETWORK

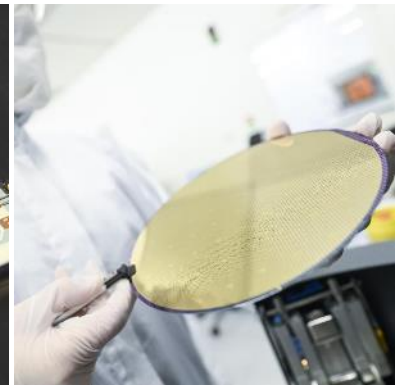
SILICON AUSTRIA LABS

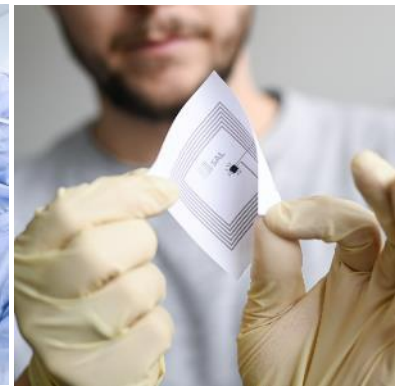
What do we do?

Silicon Austria Labs (SAL), established in 2018, is a European **R&D center** with a focus on the development of efficient and trustworthy technologies in the field of Electronics and Software Based Systems**.**

- Industry-oriented research
- R&D services
- Well-equipped research infrastructures
- Customized opportunities for cooperation



KEY FACTS*

SAL SILICON AUSTRIA LABS

Who we are

Founded: 2018

3

LOCATIONS
- Graz (HQ)
- Villach
- Linz

> 90

PARTNER NETWORK
- From Industry & Research

> 300

EXPERTS
- Experienced team
- 40 nations
- Multidisciplinary

128

PUBLICATIONS

5

SHAREHOLDER
- 50,1 % Republic of Austria (BMK)
- 24,95 % FEEI
- 10 % Styria (SFG)
- 10 % State of Carinthia
- 4,95 % Upper Austria (UAR)

32 Mio. €

PROJECT VOLUME
- Total volume for research projects

APPLIED CPS
European Digital Innovation Hub
https://www.applied-cps.at/

Co-funded by the European Union

FFG Federal Ministry Republic of Austria Labour and Economy

*2022

EPIC
EUROPEAN PHOTONICS INDUSTRY CONSORTIUM

OUR EXPERTISE

SAL Divisions

SENSOR SYSTEMS

POWER ELECTRONICS

INTELLIGENT WIRELESS SYSTEMS

MICRO-SYSTEMS

EMBEDDED SYSTEMS

INDUSTRIES

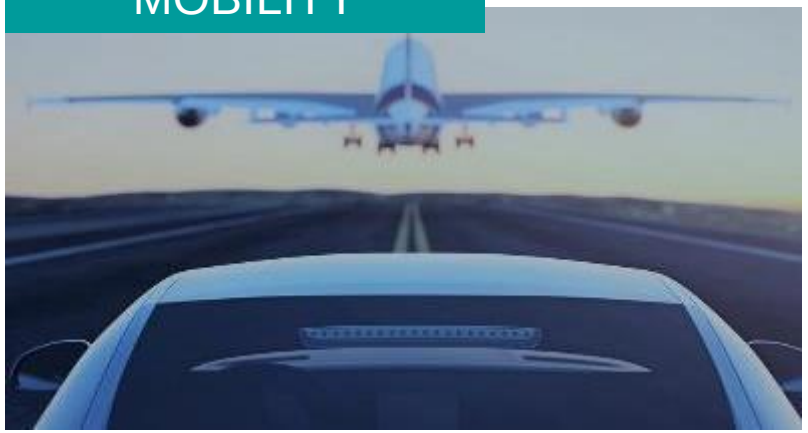
SAL as a partner for all industries

SAL SILICON AUSTRIA LABS

ENGINEERING

ENERGY

MOBILITY



ELECTRONICS

MEDICAL

CHEMICAL & PHARMA

SAL MICROFAB

SAL SILICON AUSTRIA LABS

Focus:

- ISO 4 / 1000 m² cleanroom
- Serving the full value chain of ESBS
- Research – Prototyping – Small Series

Cleaning

Lithography

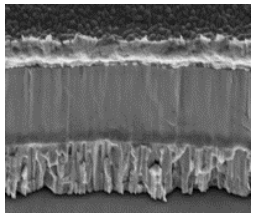
Deposition

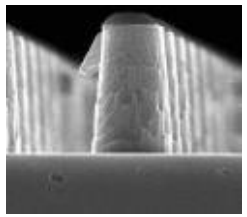
Etching

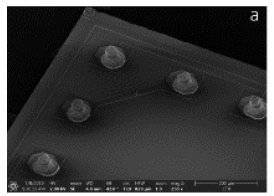
Metrology

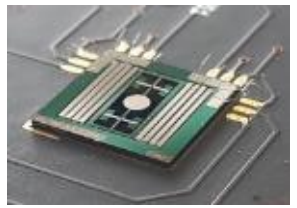
Chip

Packaging









APPLIED CPS
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EPIC
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HETEROGENEOUS INTEGRATION
APPLICATION DOMAINS

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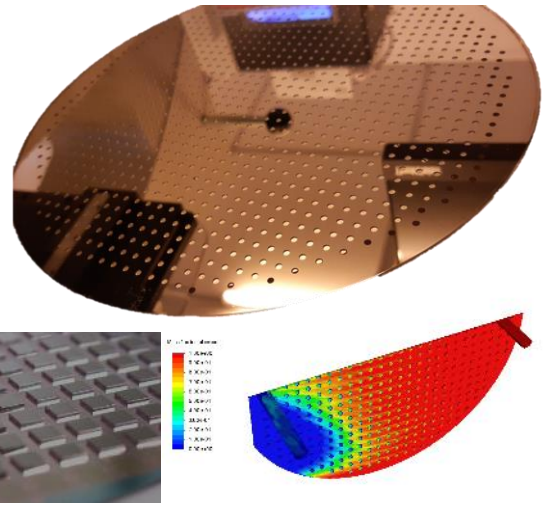
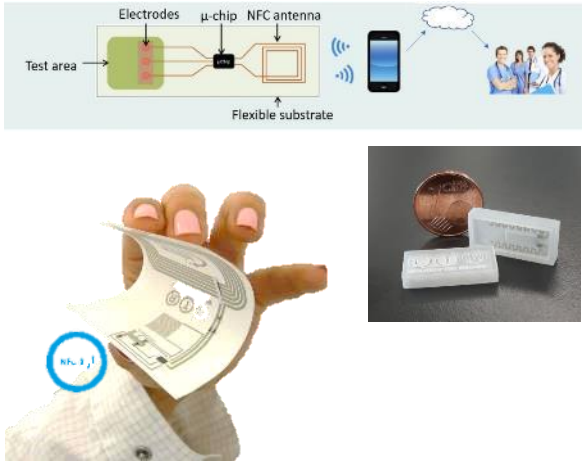
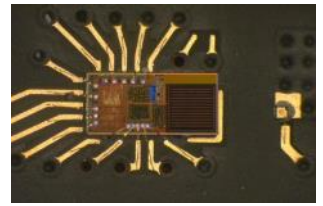
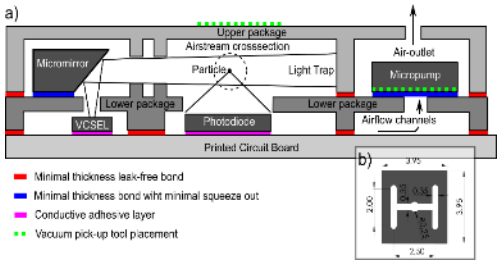
Waferlevel Integration	Hybrid Electronics Integration	Power Device Integration	Photonic Integration
			 
• W2W and C2W integration • MEMS capping technologies • Anodic, thermocompression, eutectic solder, glass frit adhesive bonding	• Chip on Flex (PET, paper,…) • Low temperature bonding technologies • Additive Manufacturing Technologies	• Power device integration for high electrical, thermal performance, reliability and lifetime • Power SiP (wirebondless, integrated passives, …)	• Miniaturisation of Macroscopic Systems to mesoscale and waferlevel • Co-integration of photonic integrated circuits (PICs) to a photonic system

PACKAGING @ SAL

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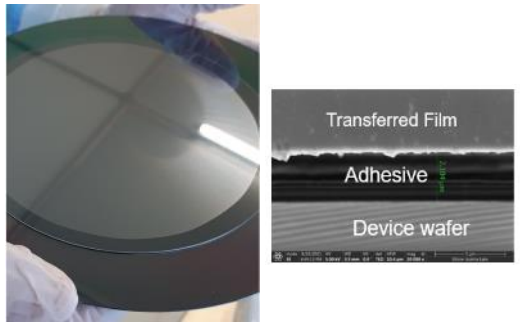
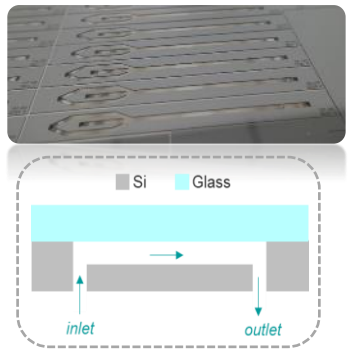
Wafer Level Packaging

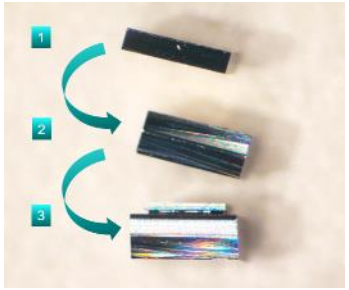
- Chip-scale wafer-level packaging (CSP)
- W2W and C2W integration
- Anodic, thermocompression, eutectic solder, glass frit adhesive bonding
- Surface preparation for fusion / Hybrid bonding
- MEMS capping technologies
- Permanent & temporary wafer bonding,
- Layer transfer
- Ultra-fine pitch technology for Substrate IC / PCB

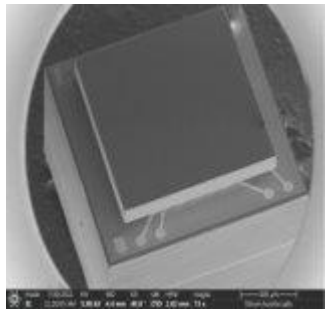


Layer transfer via wafer bonding



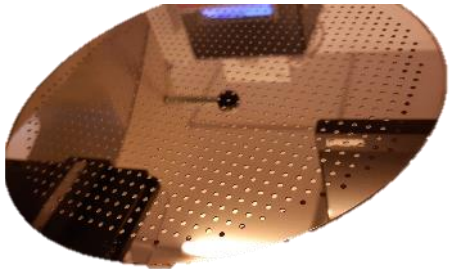
Microfluidic structures via wafer bonding

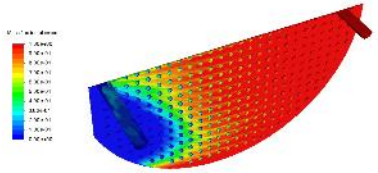




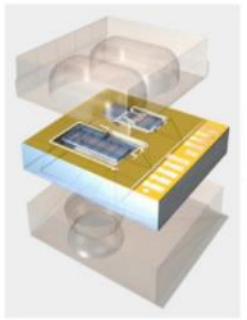
CO2 sensor made by triple stack wafer bonding

Wafer-level atomic cells

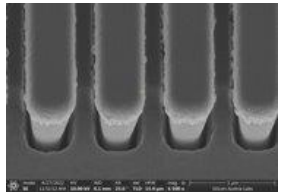


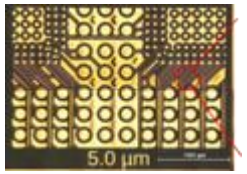


Triple stack anoding bonding with efficient gas filling

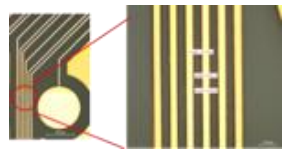


Plasma physics understanding of anodic bonding for Tire-Pressure Monitoring System





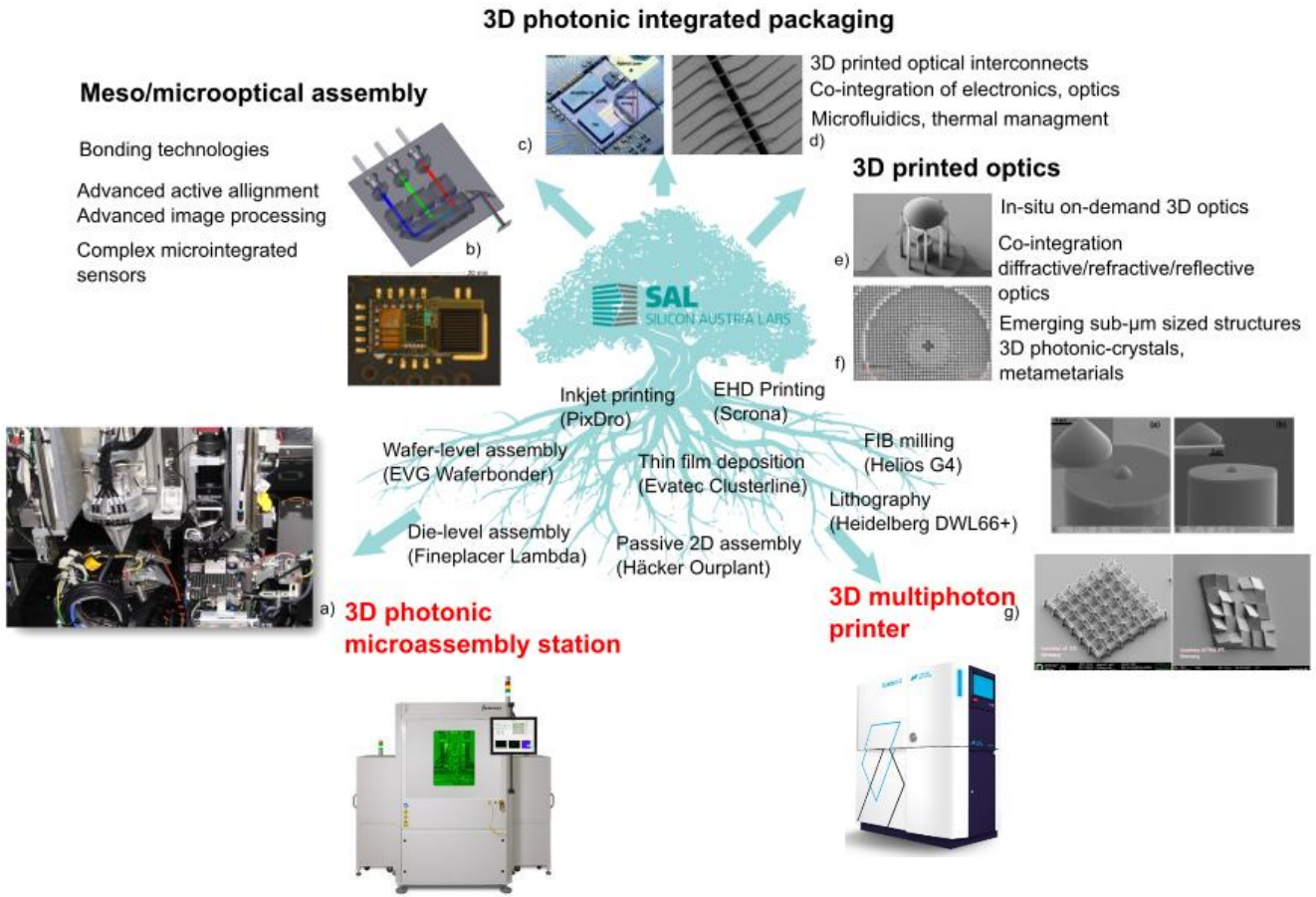
Cu RDL on ABF for Ultra High-Density interconnect PCB



PACKAGING @ SAL

Photonic Packaging

- Co-design of the various optical modules
- Enabling manufacturing technology to support innovative optical designs
- High accuracy alignment of interfaces for coupling the light into the PICs and out of PICs using active and passive optical components for numerous applications.
- Assembly of electronic and photonic components for system-in-package for desired application with high performance.
- 3D photonic integrated packaging
- In-package printing of optical components using TPP for light beam steering with sub-micron accuracy, overcomes the need of external optical components, hence, reducing the package size.

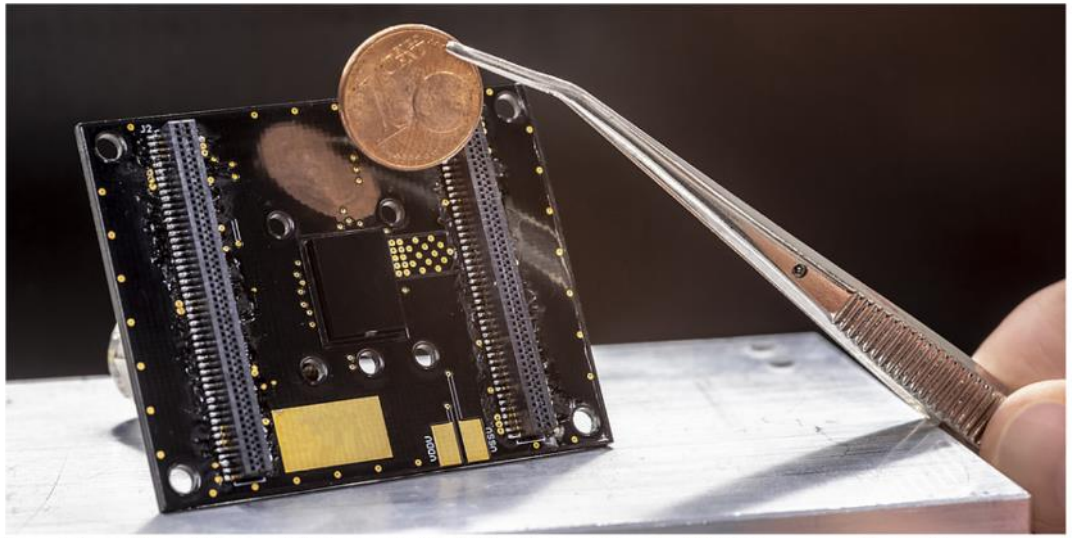


Photonic 3D Microintegration Sub-µm accuracy, 6 degrees of freedom, active alignment

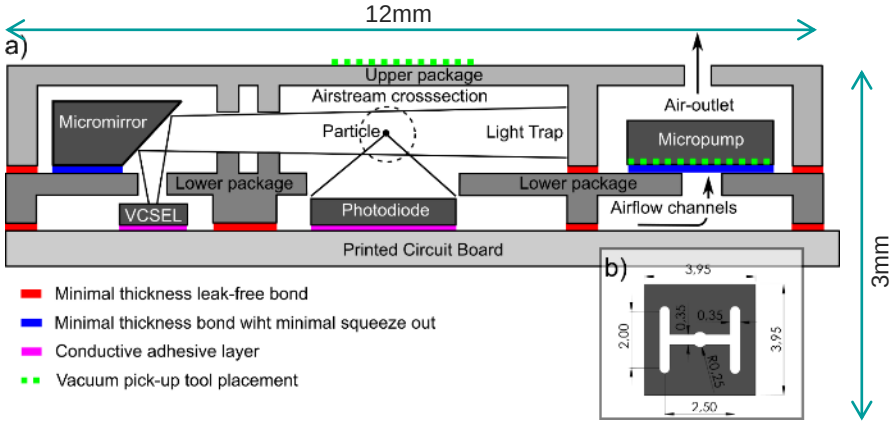
PHOTONIC INTEGRATION
PARTICLE SENSOR

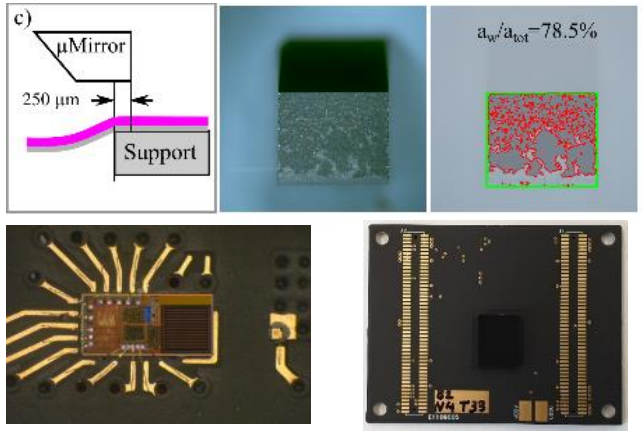
Novel vacuum assisted selective adhesive imprinting for MOEMS:

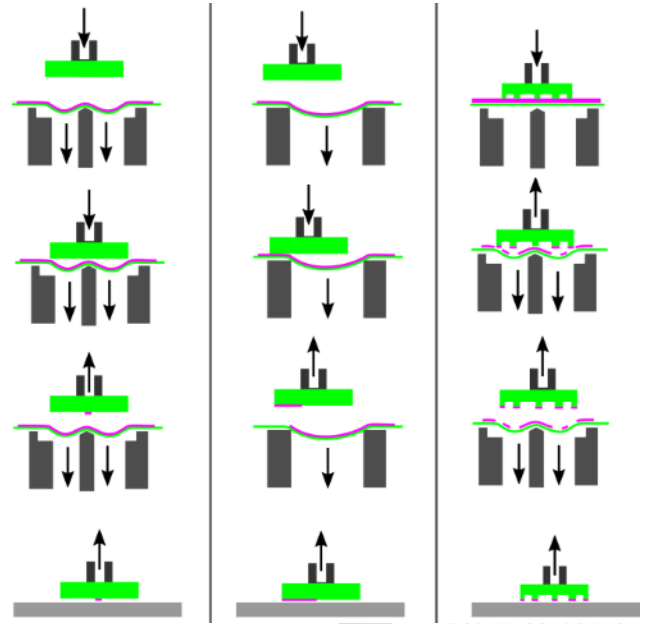
- Precise 3D manipulation of optical components in 6 DOF
- Passive 3D allignment with +/-5µm in all three dimensions
- Ultra-thin adhesive layers
- Controlled i.e. zero squeeze out
- Min. feature size of 20µm
- Airtight /hermetic assembly for gas sensors
- Extensive knowhow on active alignment using interferometry and wavefront sensing



The prototype of the particle sensor (black square in the middle of the board) developed at TU Graz compared in size with a one-cent coin. © Lunghammer – TU Graz

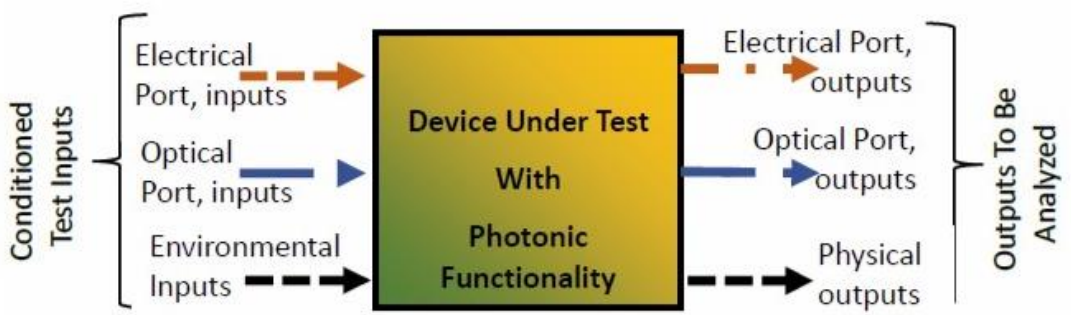






PHOTONIC PACKAGING: DEVICE TESTS

- Packaging of optical components such as PICs on photonic wafers, individual PIC die, System in Package (SiP) devices needs testing over a product life such as:
  - Electrical and optical:
    - Electrical connections: Flip-chip/wire bonding, sinterconnect
    - Optical connection: I/O optical fibers/ fiber arrays, adhesives etc.
  - Environmental and physical parameters



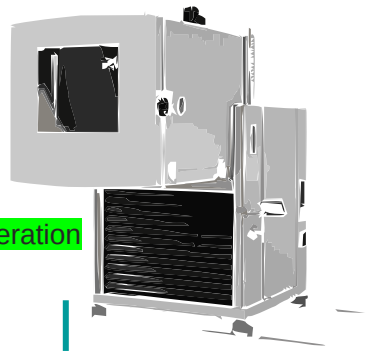
- **Electrical:**
  - Single or array of contacts for power, control, monitoring of functionality, and data input/output
- **Optical:**
  - Optical beams
  - Edge / grating coupling
  - Photonic input/output parameters: intensity, polarization, BER, SNR etc.
- **Environmental :**
  - Temperature
  - Humidity
  - Temperature cycling
  - Highly Accelerated Stress Test (HAST)
  - Vibration,
  - Shock etc.
- **Physical:**
  - Temperature rise,
  - Mechanical changes: such as delamination, cracking, swelling, and wire breaks

TIMELINE

SAL
SILICON AUSTRIA LABS

2021

Climate Chamber



In operation

2022

2023

Shaker

In operation

2024

Corrosion Chamber

In operation

Altitude Chamber

In procurement

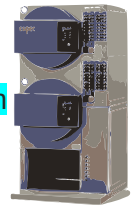
2025

Climate Tunnel

In planning phase

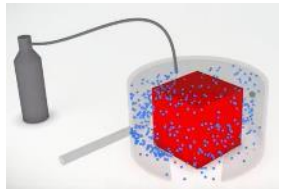
Gas Test Stand

In installation



He leakage

In installation



HAST Chamber

In procurement

Sun Chamber

In planning phase

HALT / HASS

In planning phase

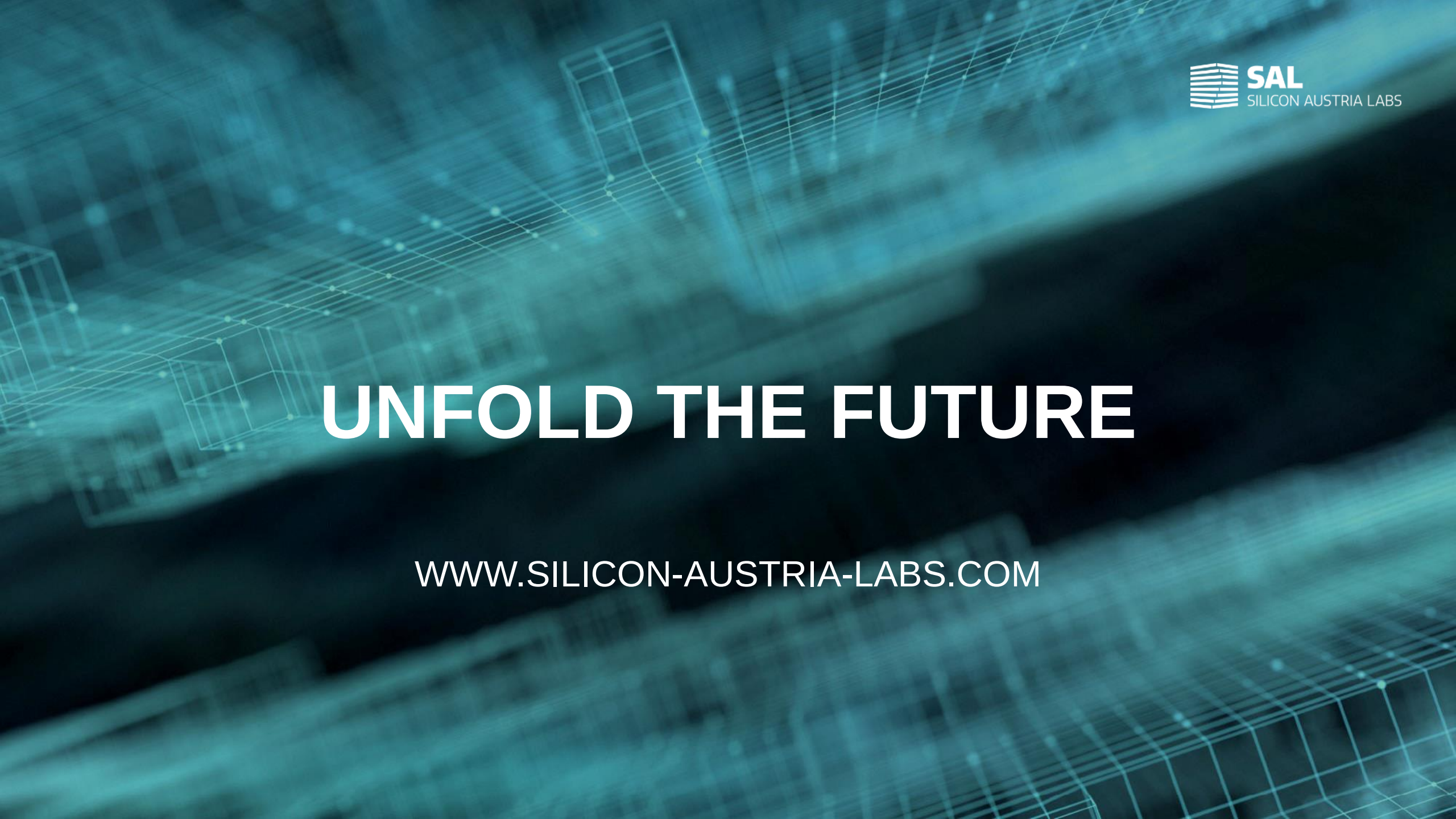
- **Gas mass spectrometer**
- **Air pollution chamber**
- **Spray and splash chamber**

APPLIED CPS

European Digital Innovation Hub (EDIH)

SAL SILICON AUSTRIA LABS

- **Services:**
  - Printed Electronics
  - Microfabrication & Characterization
  - Smart Electronic Based System Testing (Validation Lab)
  - System Integration
  - Weblink: applied-cps.at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