RealNano & ACINTECH – Projektbeispiele für Nanotechnologie in der Mikroelektronik

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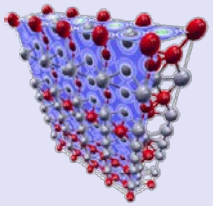
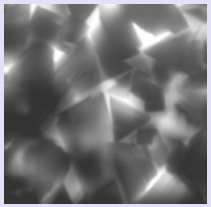
Materials Center Leoben

Our thematic focus

Integrated Materials, Process and Product Engineering

COMET K2 Center
150 employees
15,9 Mio. € turnover

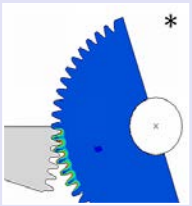
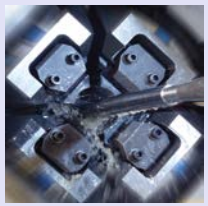
Materials Engineering

Materials design and characterization

- New materials (steels, non-ferrous alloys, sensor materials, material compounds)
- Materials simulation
- Materials characterization & testing

Process Engineering

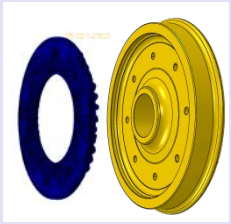
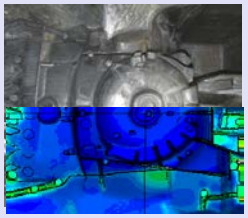
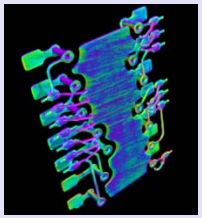



Process development and simulation

- New manufacturing processes
- New manufacturing tools
- Process simulation
- Physical based models for process control

Product Engineering

Structural components | Manufacturing tools | Functional components

Product design and product behaviour in service

- New products
- Materials & process integrated product dimensioning
- Simulation of product behaviour in service (virtual testing of structures, reliability, condition monitoring)

Materials & process technology along the value chain for industry branches with materials-enabled innovations from material synthesis to the end of service

Metallurgical; Chemical; Mechanical engineering; Electronics; ...

Manufacturing; Supply; Electronics; ...

Automotive, railway & aerospace; Mechanical engineering; Power generation; Electronics; Medical instruments; ...

Project: RealNano
Industrial Realization of innovative CMOS based Nanosensors

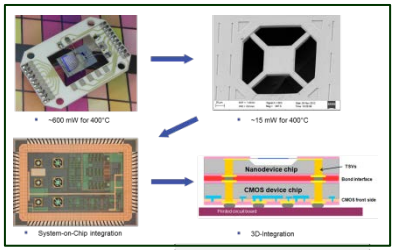
Funded by:
FFG

- **Objective:**
  Development of an innovative process chain and production tools for the industrial fabrication of CMOS based 3D-integrated nanosensors on wafer-scale.
- **Project period:** 1.4.2014 – 31.10.2016
- **Project volume:** 2.579 Mio. EURO
- **Partners:**
  - ams AG
  - Center for Applied Nanotechnology CAN GmbH
  - E V Group E. Thallner GmbH
  - JKU Linz, Inst. Semiconductor & Solid State Physics
  - Materials Center Leoben Forschung GmbH

Project: RealNano

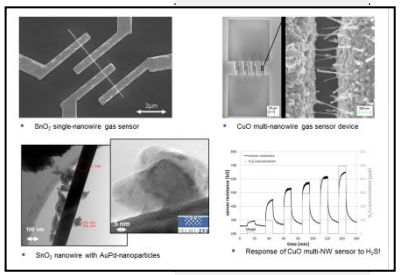
Required results from previous projects

CATRENE-Project COCOA: Chip-On-Chip technology to Open new Applications (ST-Microelectronics + 19 partners, 1.7.2010 – 30.6.2013)

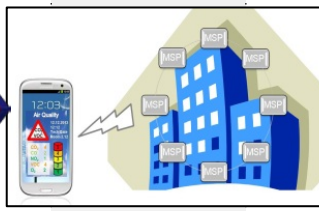


ENIAC-Project ESiP: Efficient Silicon Multi-Chip System-in-Package Integration – Reliability, Failure Analysis and Test (Infineon Technologies AG + 41 partners, 1.4.2010 – 31.3.2013)

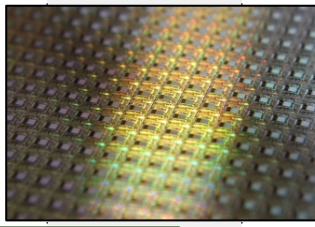
MNT-Eranet-Project NanoSmart: Nanosensor system for Smart Gas Sensing Applications (AIT + 5 partners, 1.1.2011 - 30.6.2013)



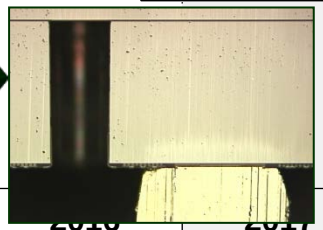
FP7-ICT-2013-10-Project MSP: Multi Sensor Platform for Smart Building Management, (MCL + 17 partners, 1.9.2013 – 31.8.2016)



PdZ Project RealNano - Industrial Realization of innovative CMOS based Nano-sensors, (MCL + 4 partners, 1.4.2014 – 31.10.2016),

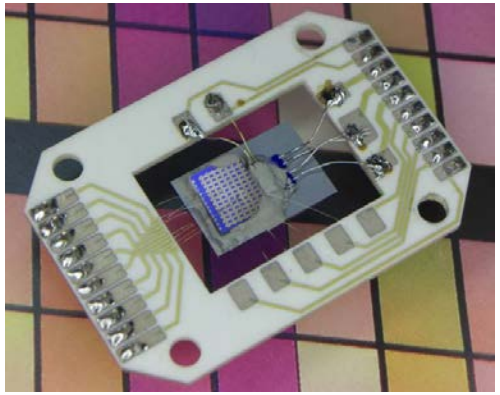


IP Project ACINTECH: Active Interposer Technology for 3D-Integration of electronics devices, (MCL + 2 partners, 1.2.2013 – 31.1.2016)

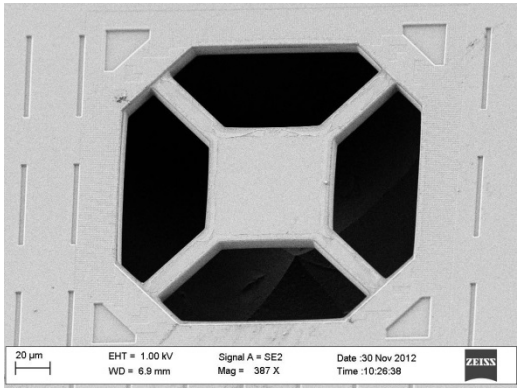


Year	2010	2011	2012	2013	2014	2015	2016	2017

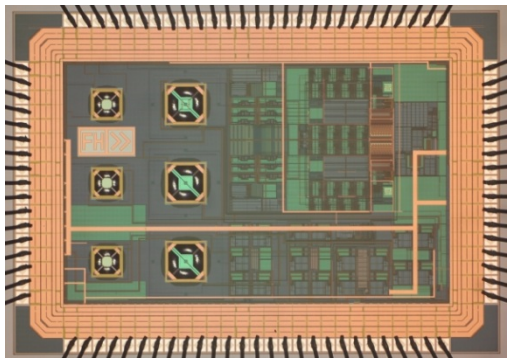
Results of COCOA und ESiP



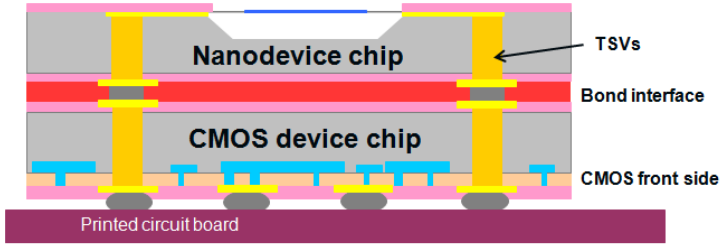
- ~600 mW for 400°C



- ~15 mW for 400°C



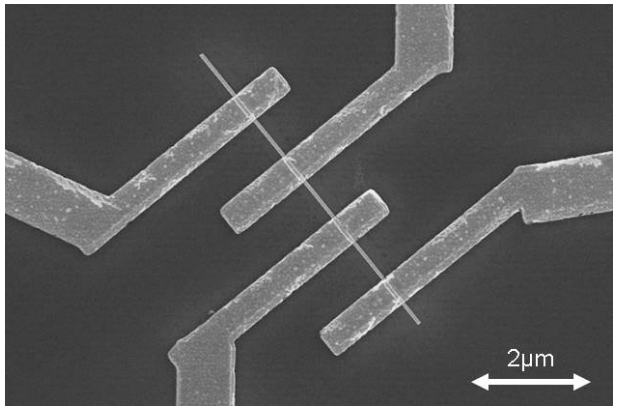
- System-on-Chip integration



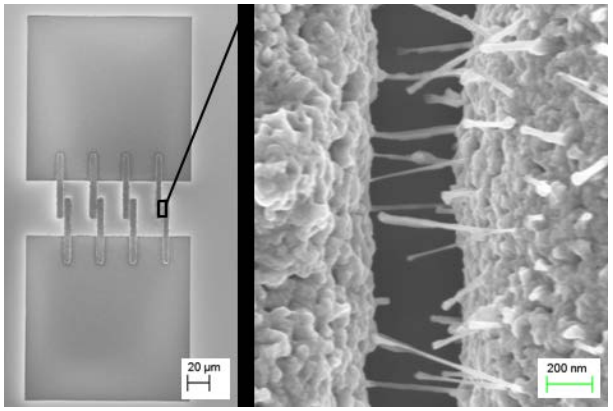
- 3D-Integration

- Development of micro-hotplate devices for gas sensors, CMOS integrated nanocrystalline, ultrathin gas sensing films, System-on-Chip development (implementation of circuitry) based on Through-Silicon-Vias (TSVs), and 3D-Integration.

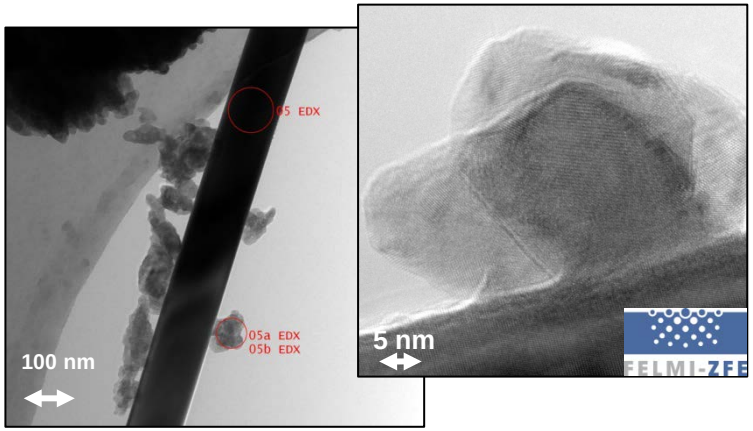
Results of NanoSmart



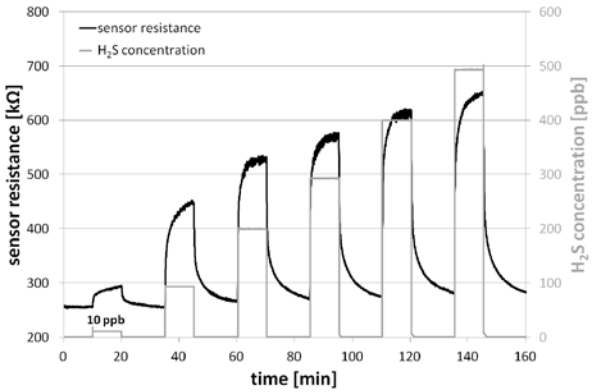
- SnO_2 single-nanowire gas sensor



- CuO multi-nanowire gas sensor device



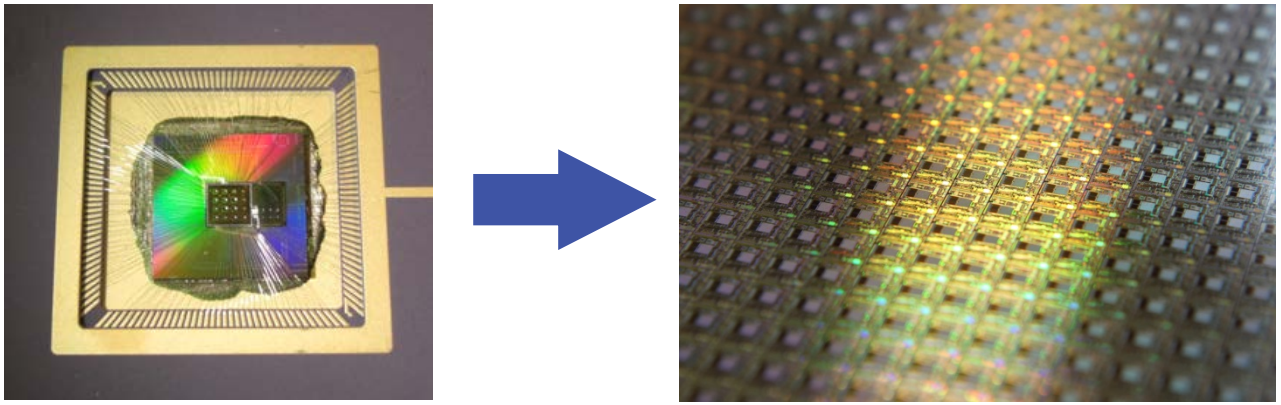
- SnO_2 nanowire with AuPd-nanoparticles



- Response of CuO multi-NW sensor to H_2S!

- Implementation of SnO_2 and CuO nanowires (NW) as gas sensor components on CMOS fabricated micro-hotplate chips, functionalization with (bi)metallic nanoparticles (nanoparticles: AuPt, AuPd, PtPd,…), optimizing gas sensor performance !

RealNano: Evolving nanosensors from lab-scale to wafer-scale!



- Partner roles (unique scientific & technological expertise along the value chain available in Austria)

JKU	Synthesis of (bi)metallic nanoparticles
CAN	Application of industrial nanoparticle fabrication process, and upscaling of the nanoparticle fabrication process for commercialization
MCL (CL)	Fabrication of gas sensors based on ultrathin nanocrystalline films and nanowires (SnO_2, CuO, ZnO)
EVG	Upscaling the nanowire fabrication procedure, development of tools for nanowire transfer to CMOS wafer, and development of spray pyrolysis tool capable for production on 200 mm wafer scale
AMS	CMOS integration of gas sensors, fabrication of microhotplate chips and 3D-integrated devices on 200 mm wafer scale

Project: ACINTECH

Active Interposer Technology for 3D-Integration of electronics devices

Funded by:

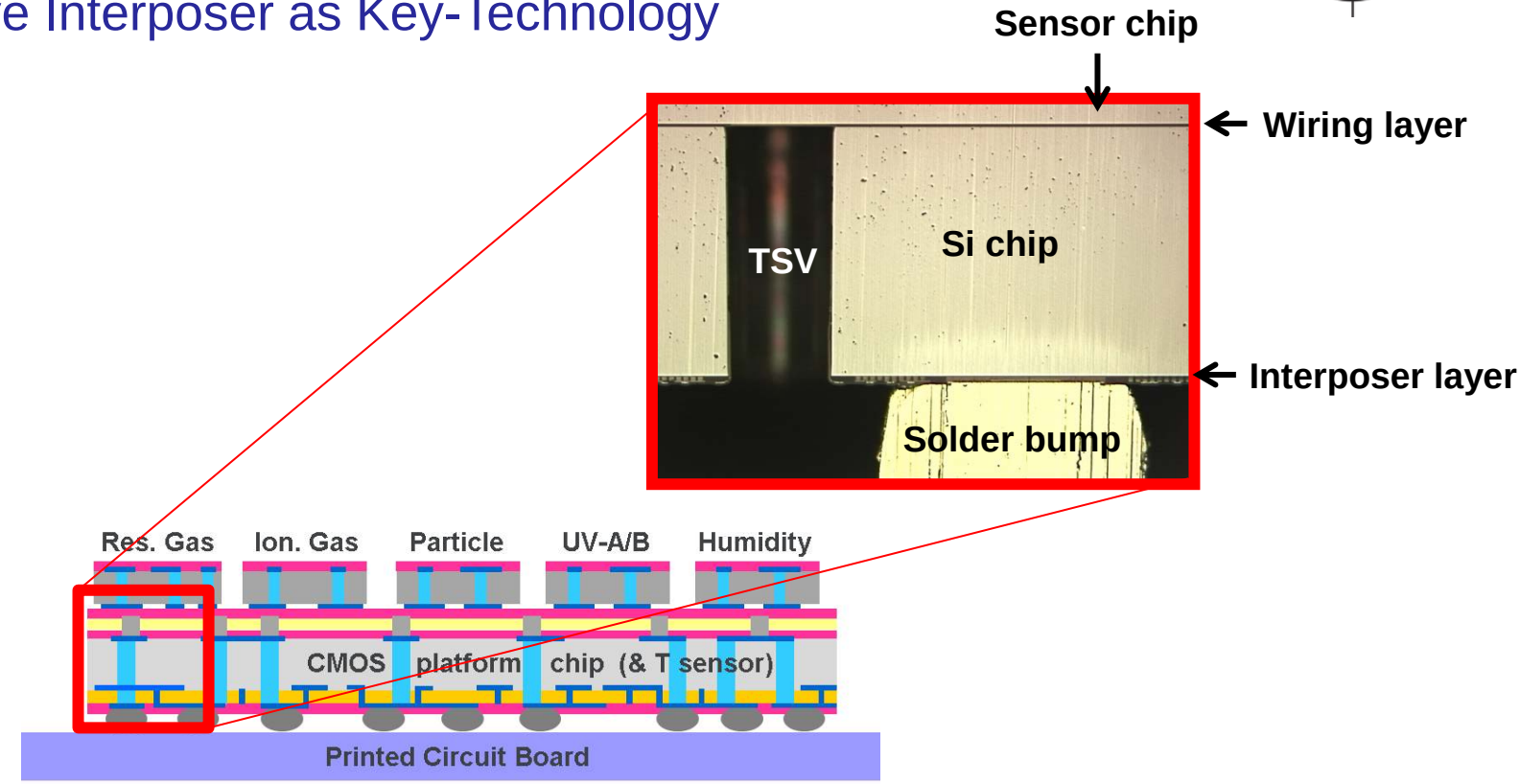
FFG

- **Objective:**
  Developing of fundamentals to increase the yield and reliability of 3D-integrated microelectronic systems including the development of robust designs and processes for advanced connectivity technology in electronic circuits.

- **Project period:** 1.2.2013 – 31.1.2016
- **Project volume:** 1.287 Mio. EURO
- **Partners:**
  - ams AG
  - Materials Center Leoben Forschung GmbH
  - Montanuniversität Leoben

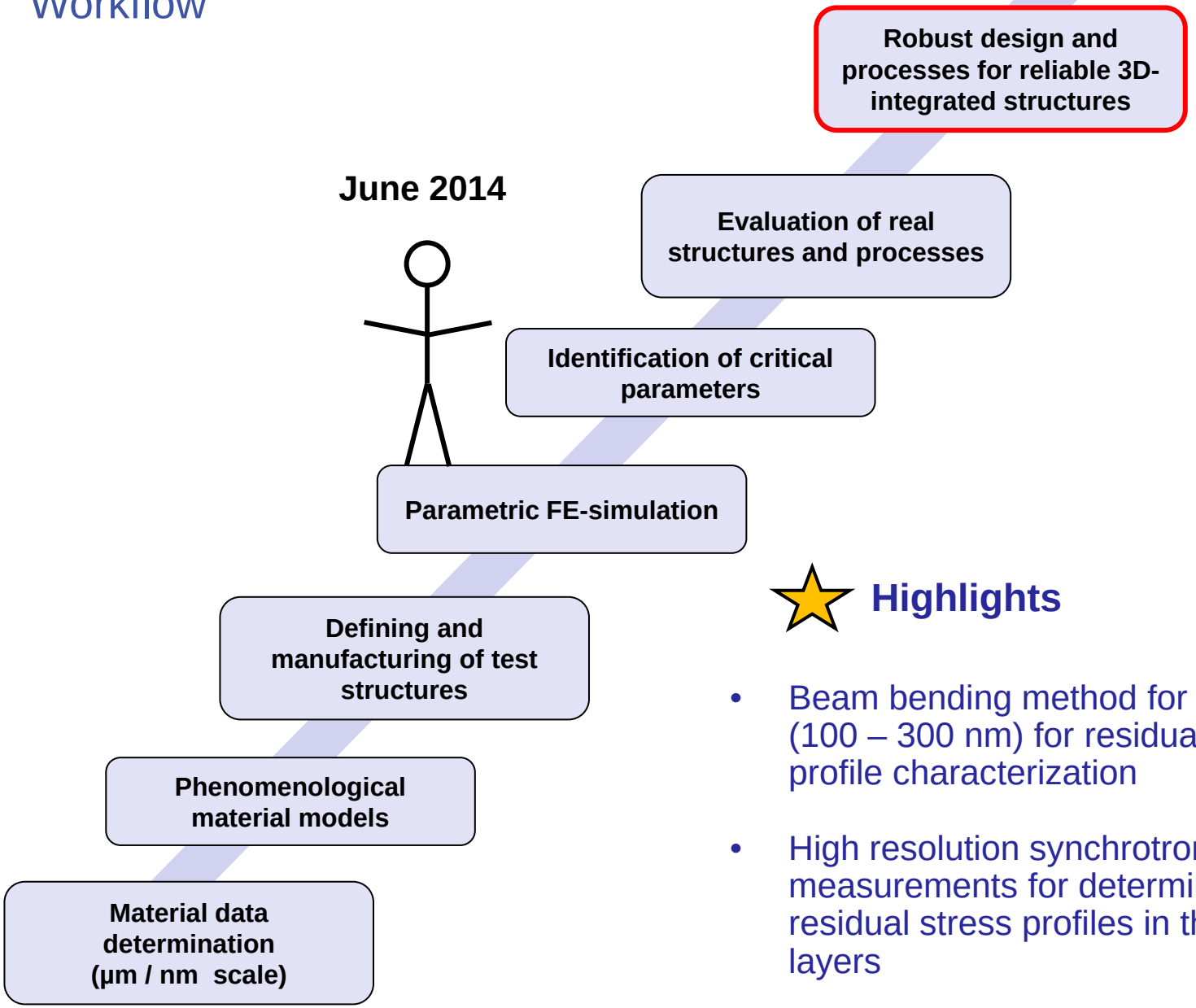
MONTAN UNIVERSITÄT
WWW.UNILEOBEN.AC.AT

Active Interposer as Key-Technology



- **Increased & new functionalities** due to 3D integration (More-than-Moore)
- **Challenges:**
  - Safety against thermomechanical failure modes
  - Robust material, process and design concepts for reliable structures

Workflow

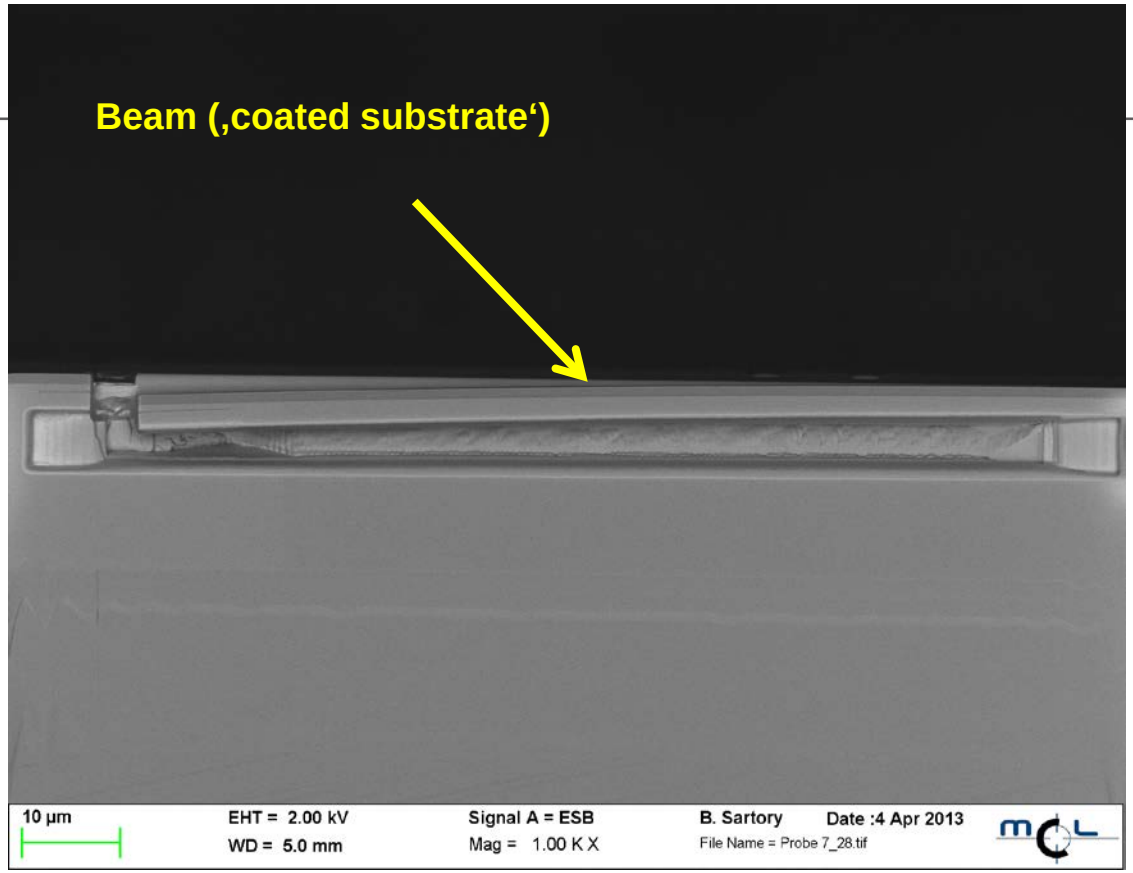


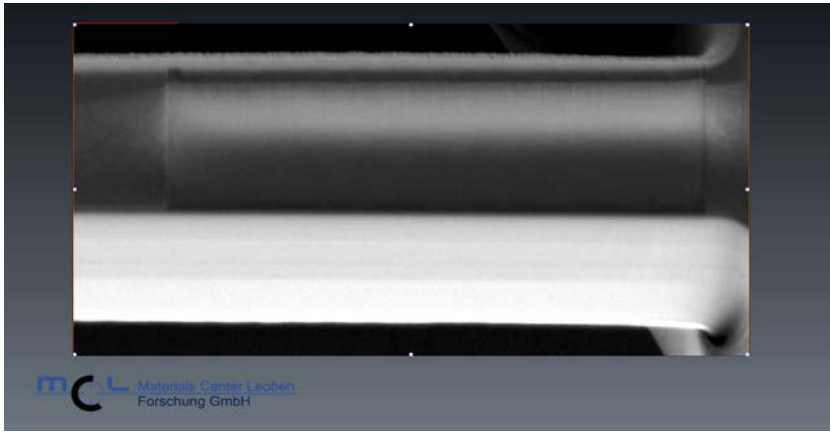
Highlights

- Beam bending method for thin layers (100 – 300 nm) for residual stress profile characterization
- High resolution synchrotron-measurements for determining residual stress profiles in thin TSV layers

Project: ACINTECH

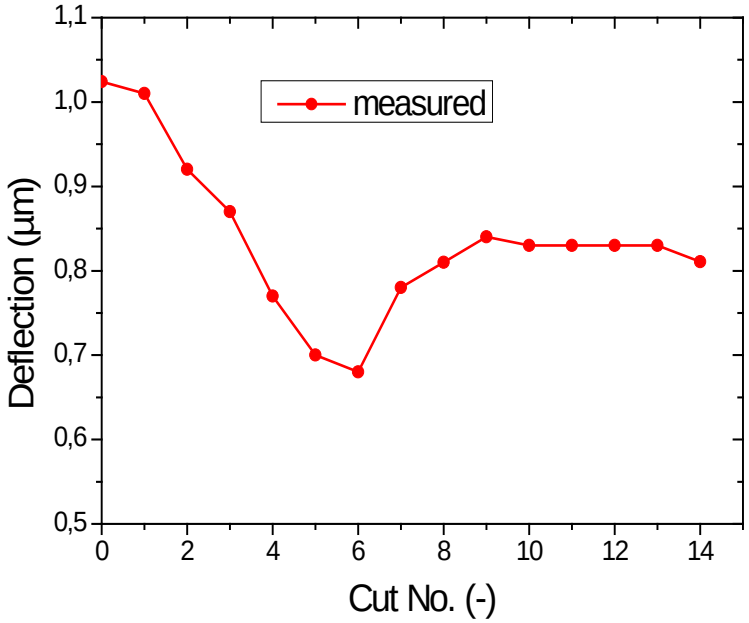
Beam bending method for residual stress characterization in thin films



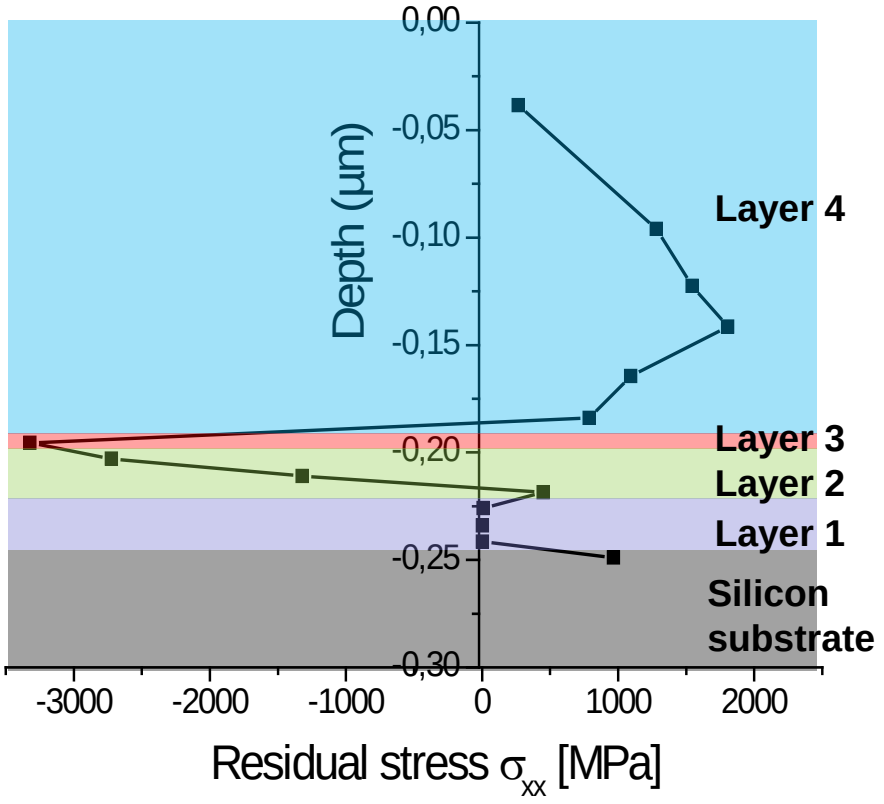


Method developed in collaboration with Erich Schmid Institute, Austrian Academy of Sciences

Beam bending method for residual stress characterization in thin films



- **Deflection of free beam end while removing coating layer by layer at the other end**

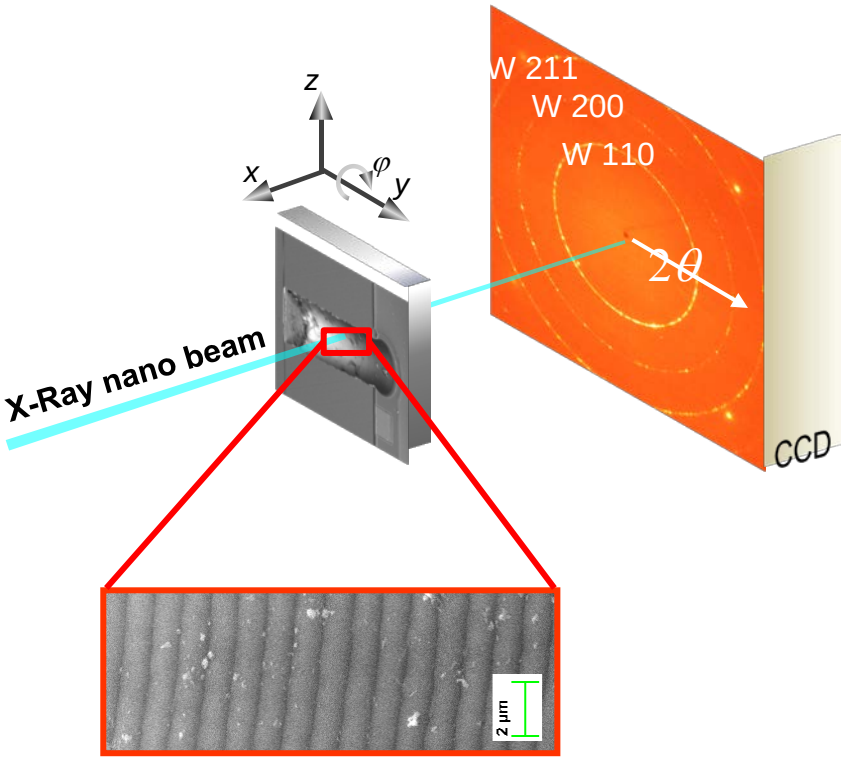


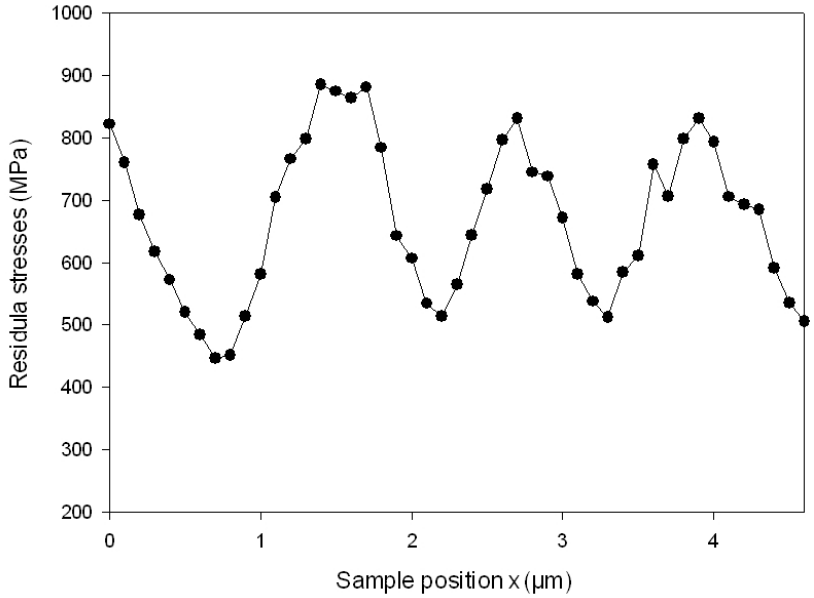
- **Residual stress profile in a 250 nm thick multilayer coating.**

Project: ACINTECH

Synchrotron based X-ray nano beam residual stress measurements

Full and sectioned TSVs were characterized position-resolved at ID13 beamline of ESRF in Grenoble using a beam size of 100nm in diameter.





Spatial resolution: < 100nm °!

nano FIS

Functional Integrated nano Systems

1st International Conference

nano FIS 2014

Functional Integrated nano Systems

3 – 5 December 2014, Graz/Austria

***nano*FIS 2014 intends to contribute to challenges and topics covered by the Mission, Vision & Strategy of the European Micro- & Nanoelectronics and to increase visibility in particular in the More-Than-Moore domain.**

www.nanofis.net

MCL MATERIALS CENTER LEOBEN

TECHKONNEX High-Tech Promotion