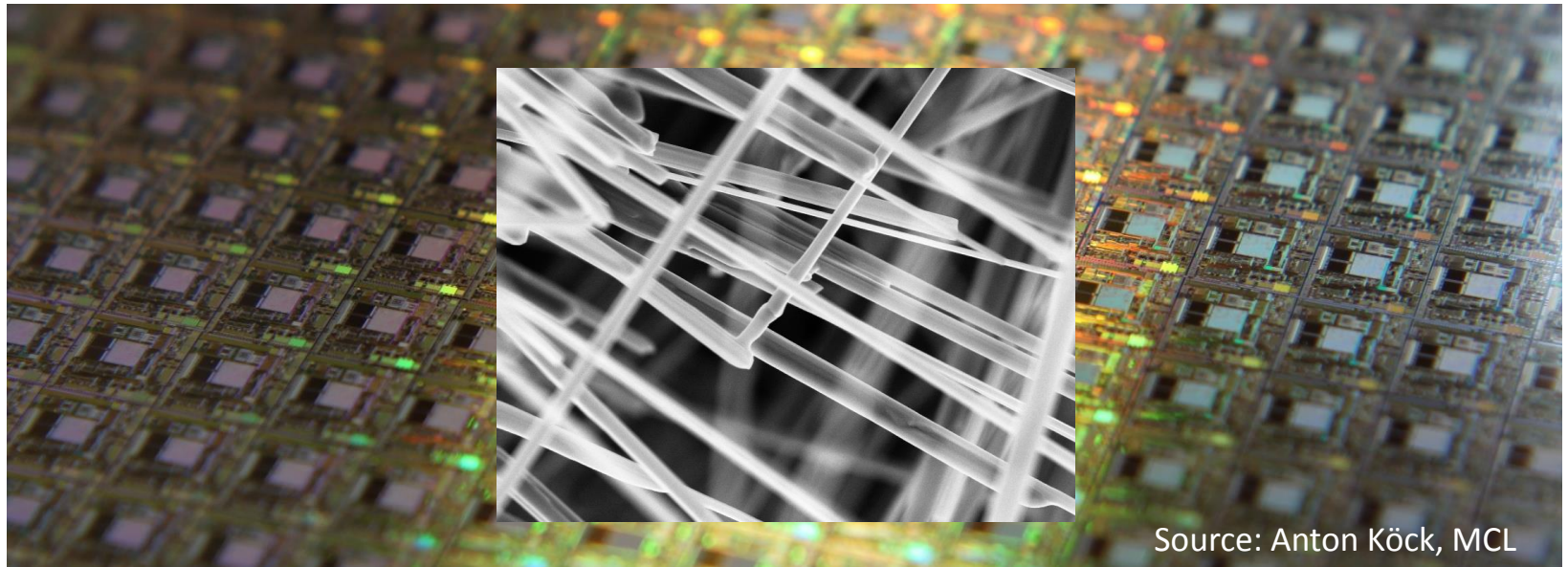


# Optimierte Funktionalisierung von Nanosensoren zur Gasetektion durch Screening von Hybrid-Nanopartikeln

Anton Köck

MCL Materials Center Leoben Forschung GmbH  
Austria



- Founded in 1999 MCL is the leading COMET K2 competence center in material science in Austria with 150 employees
- Focus is on the full materials value chain in applications & materials characterization from nano- to microscale
- Since 2012: Research area „Materials for Microelectronics“
  - Nanosensors and multi-sensor systems
  - CMOS integration & 3D-System Integration.



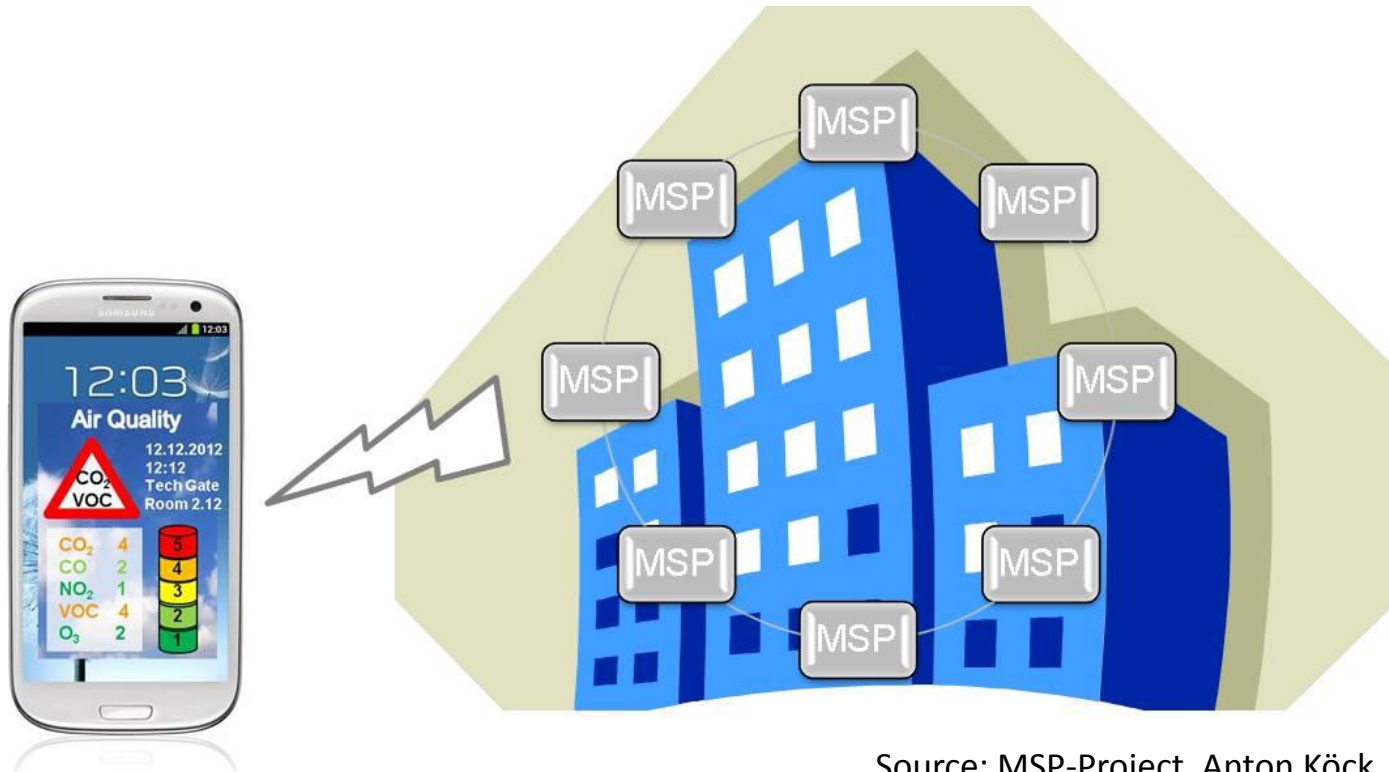
Materials Center Leoben  
Forschung GmbH  
Roseggerstrasse 12  
A-8700 Leoben  
[www.mcl.at](http://www.mcl.at)



Source: Anton Köck, MCL



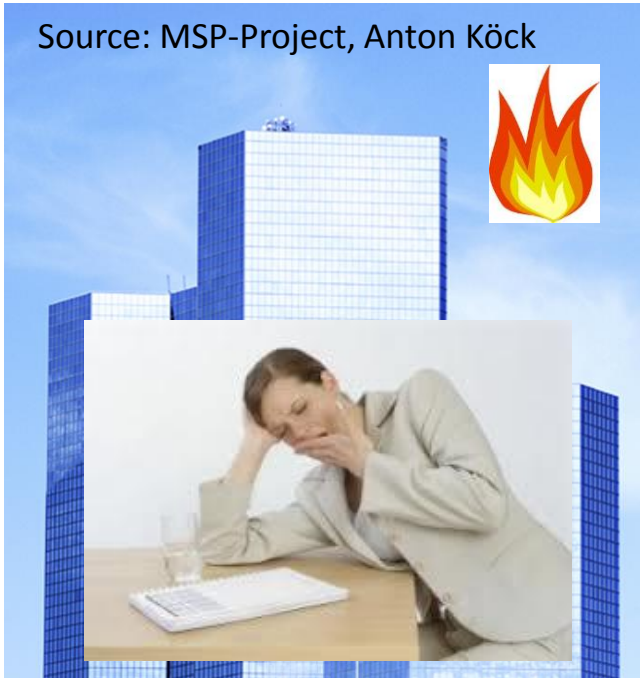
# The MSP-Project - Multi Sensor Platform for Smart Building Management



Source: MSP-Project, Anton Köck

# Target Parameters

Source: MSP-Project, Anton Köck



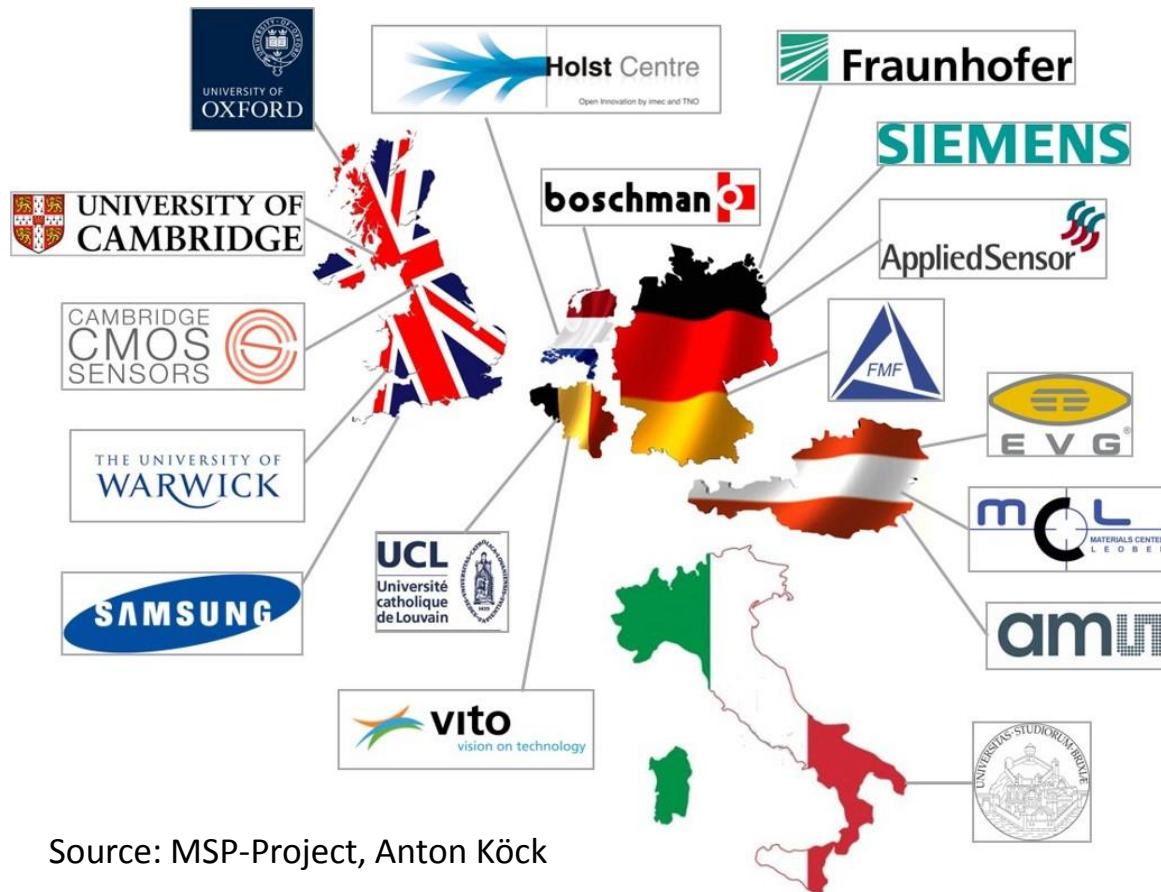
Indoors  
CO, CO<sub>2</sub>, VOCs, PM

Source: MSP-Project, Anton Köck



Outdoors  
NO<sub>2</sub>, O<sub>3</sub>, CO, PM<sub>10</sub>, PM<sub>2.5</sub>, UFPs

- 17 partners from 6 countries – 1/9/2013 – 30/4/2017
- 18.5 M€ budget and ~ 1300 PMs effort



Source: MSP-Project, Anton Köck

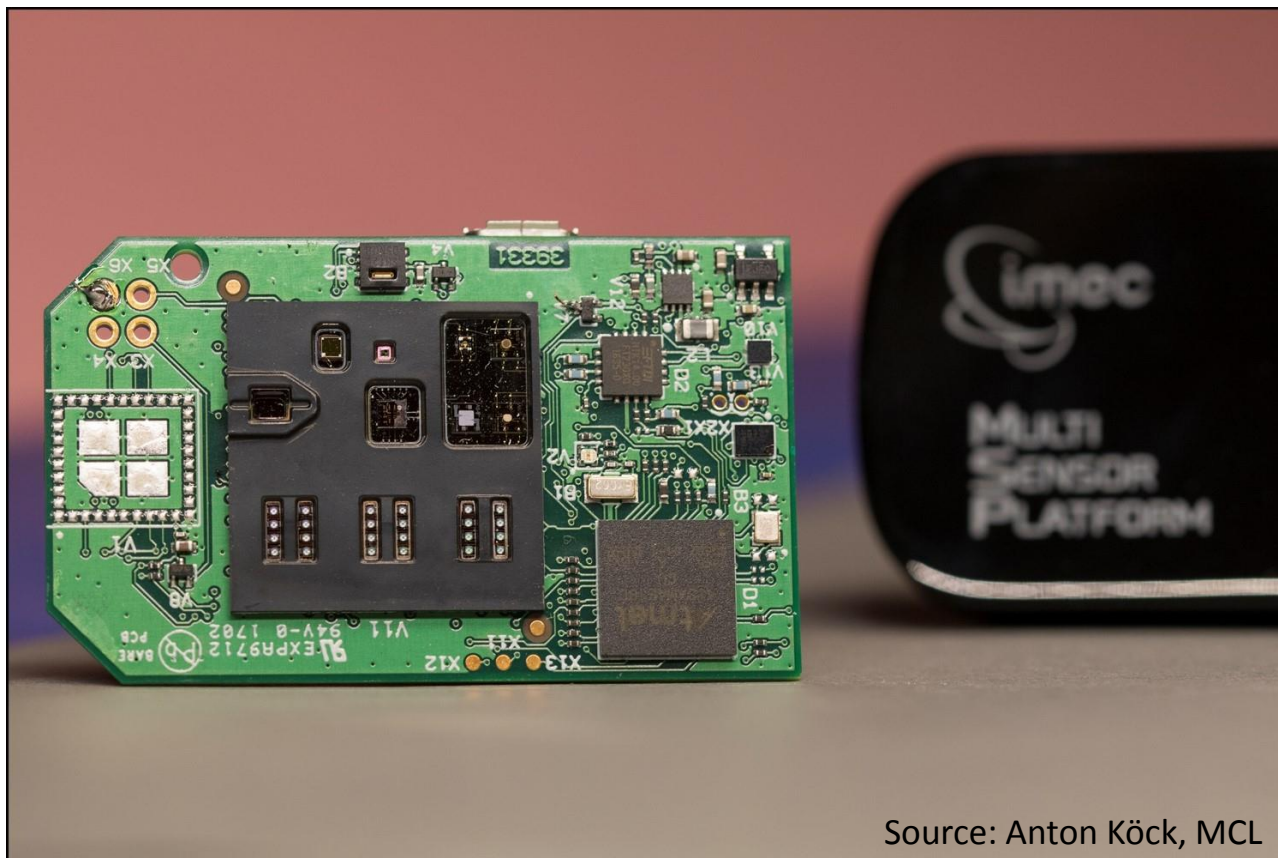
- MSP demonstrator on PCB plus battery in wristband device



Source: Anton Köck, MCL

## 6. MSP WEARABLE DEVICE

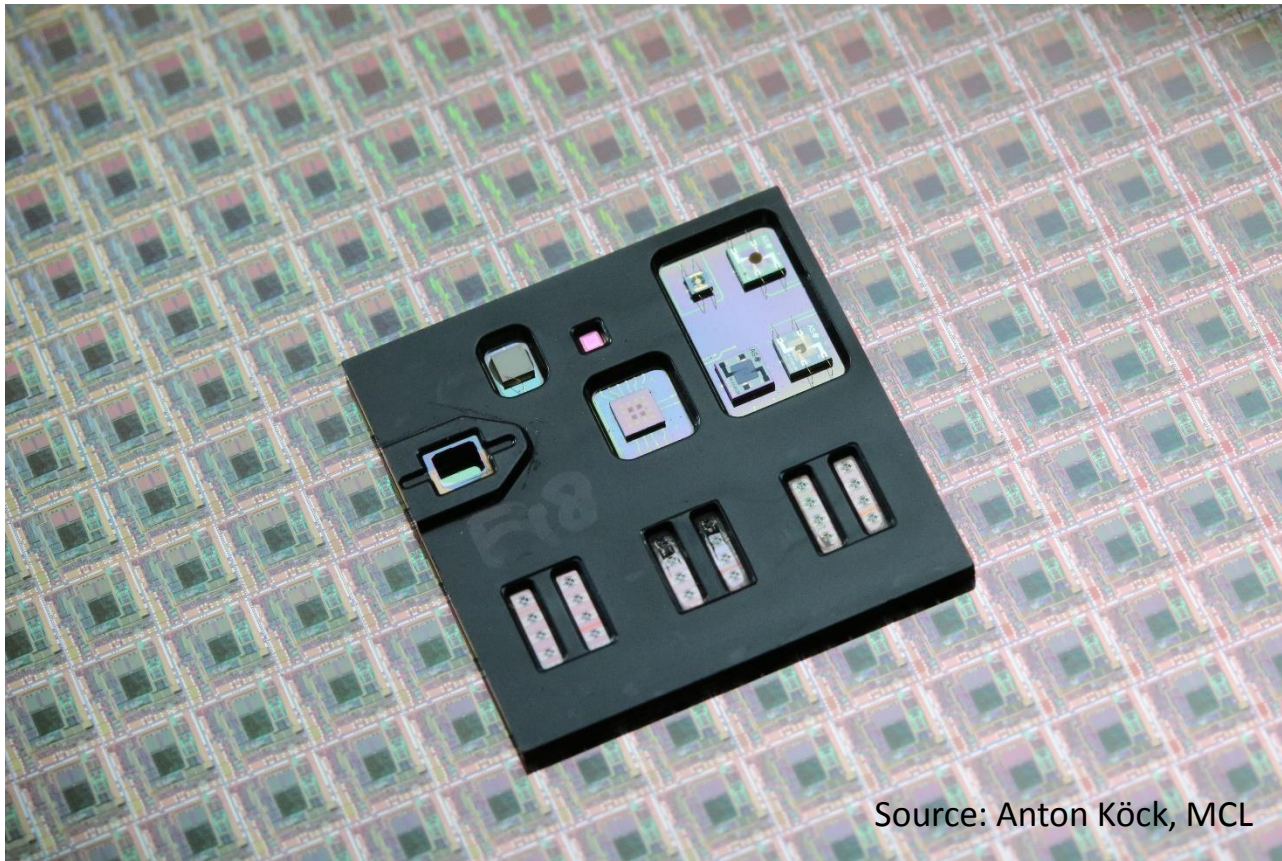
- PCB has been designed for wearable application (IMEC)



Source: Anton Köck, MCL

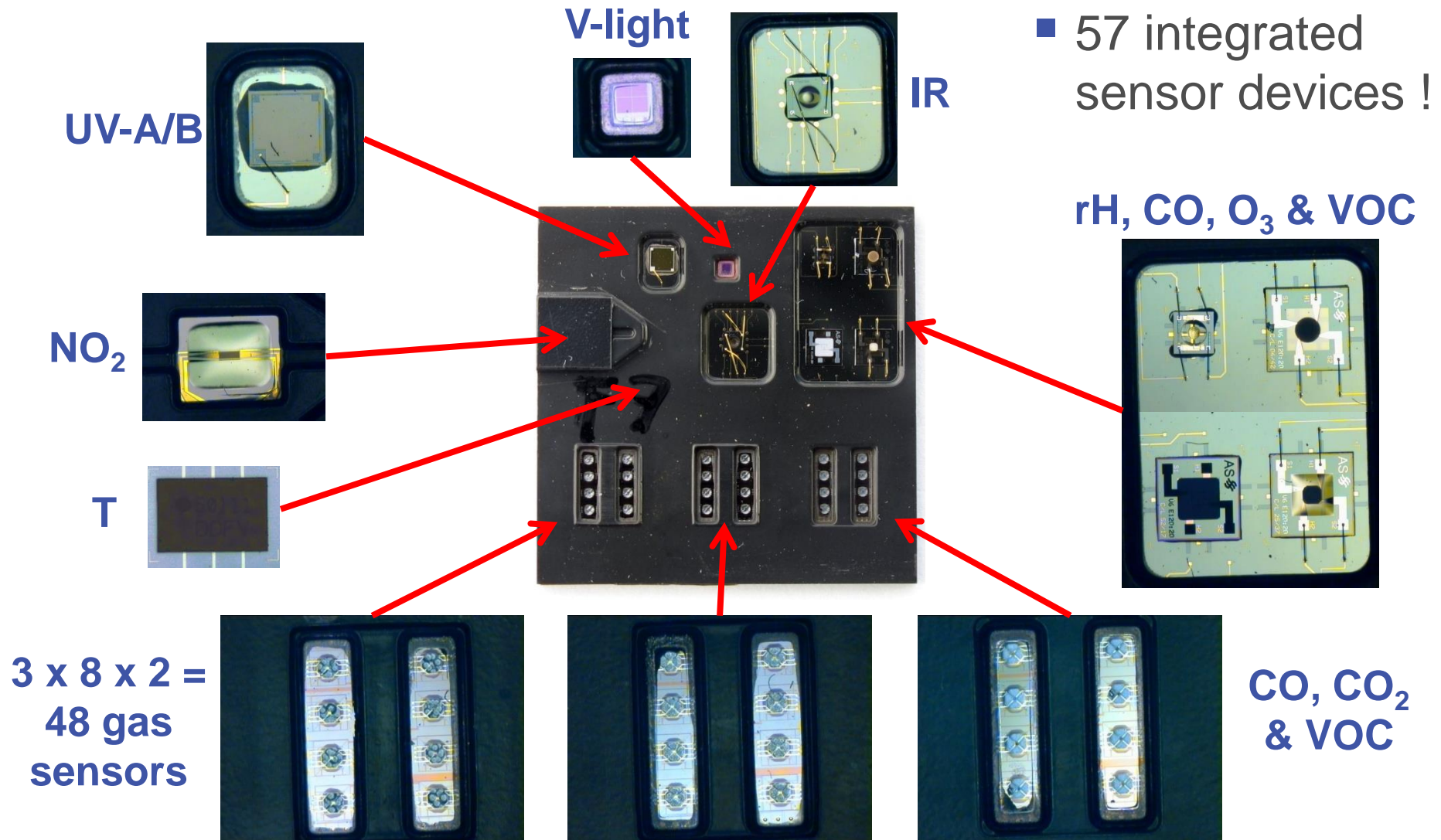


- 3D-integrated MSP Multi-Sensor System
- Worldwide unique sensor system with 57 sensors !

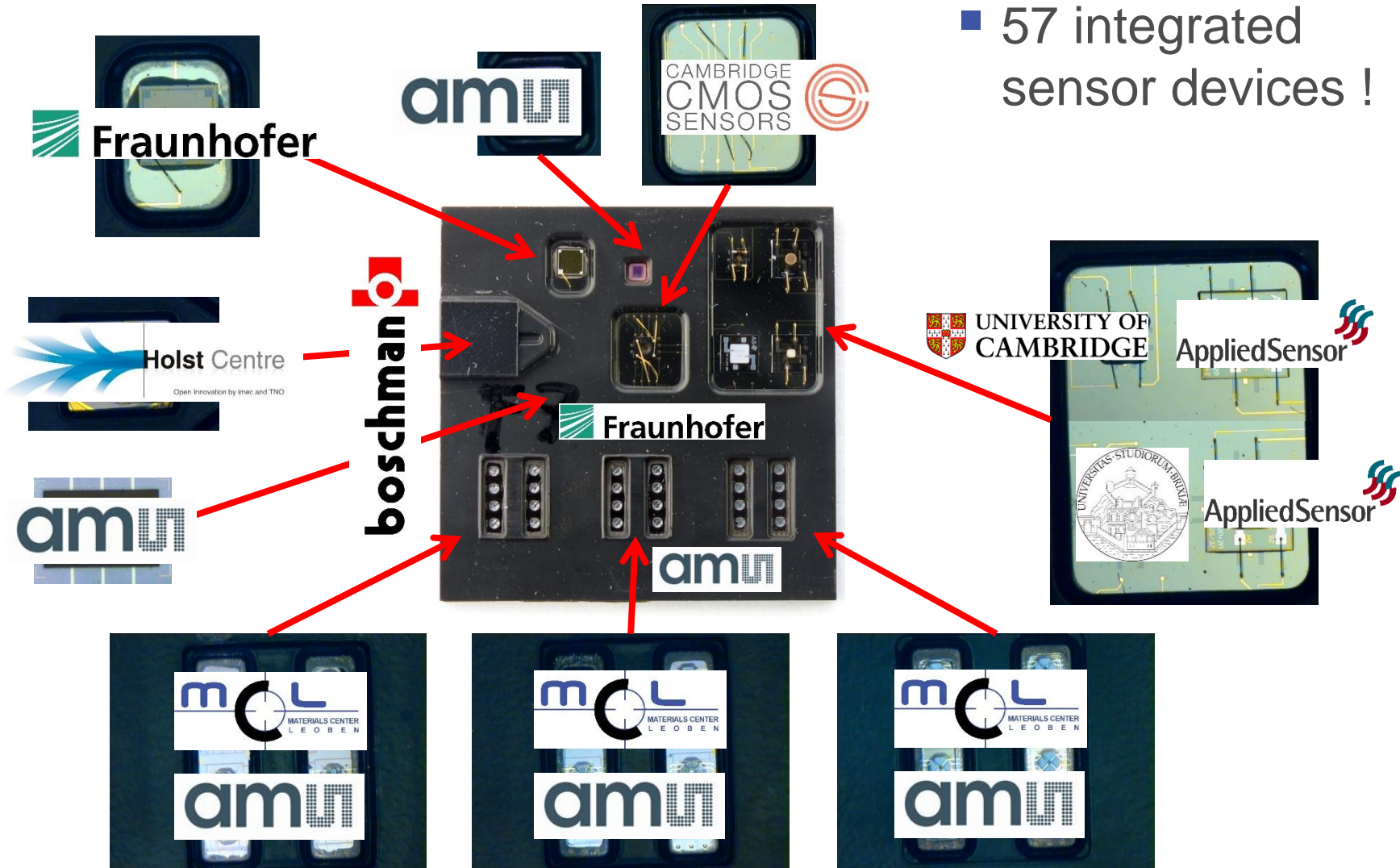


Source: Anton Köck, MCL

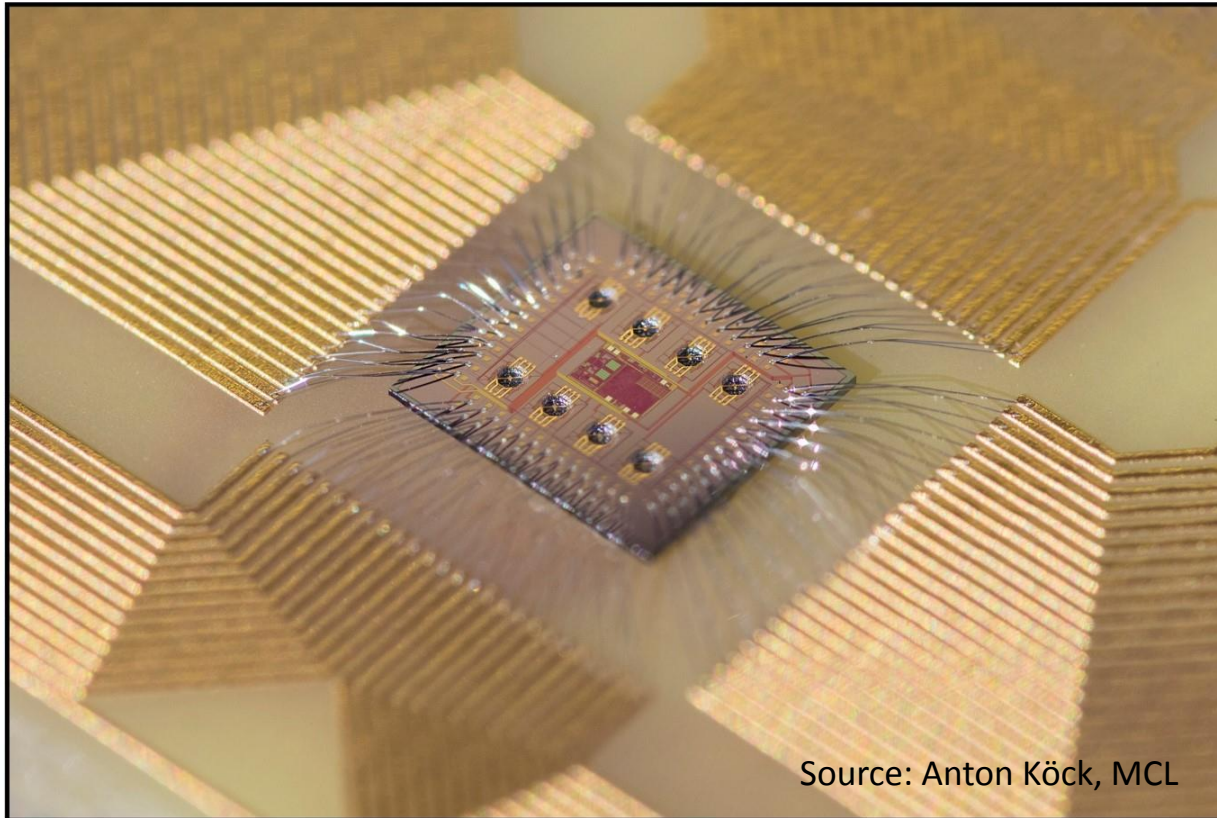




■ 57 integrated sensor devices !



- Worldwide unique CMOS based micro-hotplate Chip
- 8 micro-hotplates for 16 gas sensors (up to 400°C) (MCL, AMS)



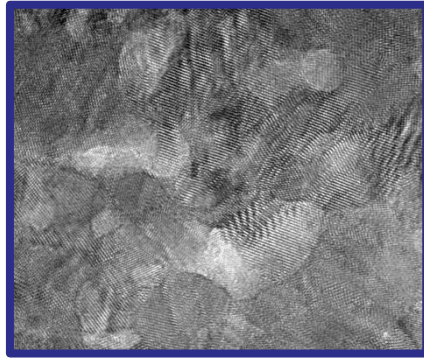
Source: Anton Köck, MCL



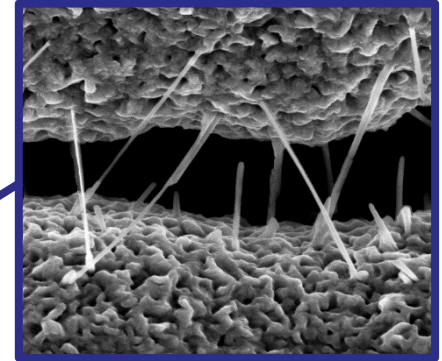
# Multi Sensor Array

- $\mu$ hps are coated with different nano materials ( $\text{SnO}_2$ , CuO-NWs)
- Functionalization with NPs

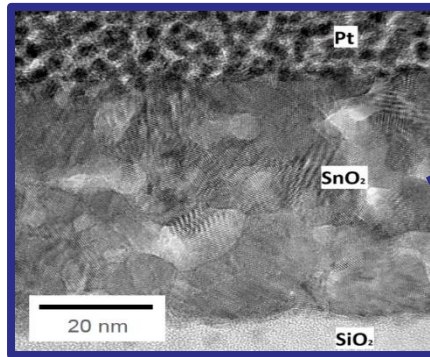
## $\text{SnO}_2$



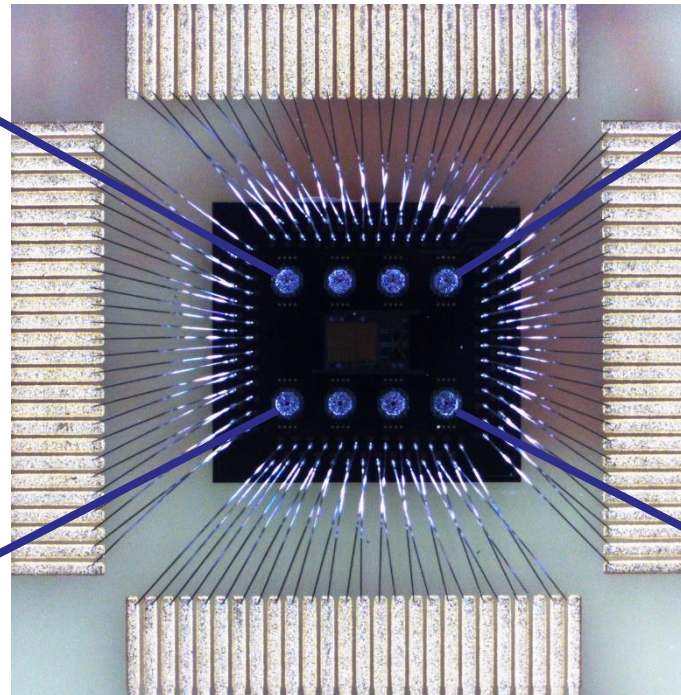
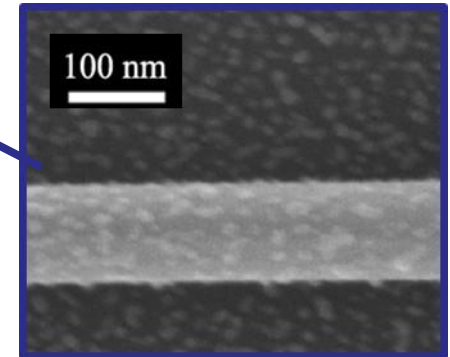
## CuO-NWs



## $\text{SnO}_2 + \text{Pt}$



## CuO + Au



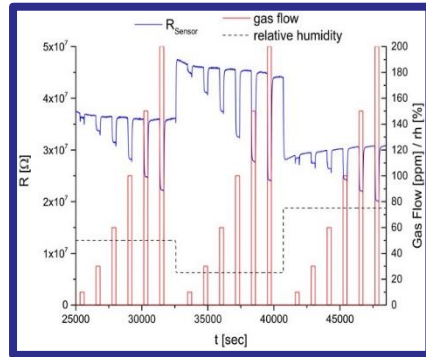
Source: Anton Köck, MCL

# Multi Sensor Array

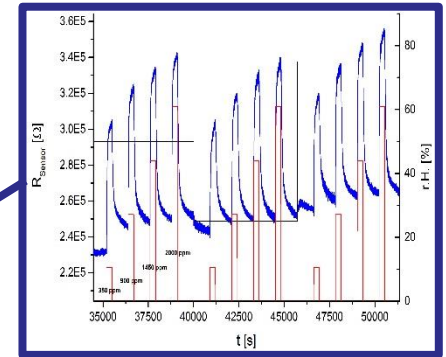


- Each sensor gives a different response to target gases CO, CO<sub>2</sub>, & VOCs

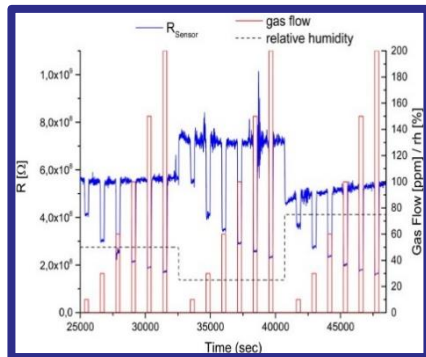
## SnO<sub>2</sub>



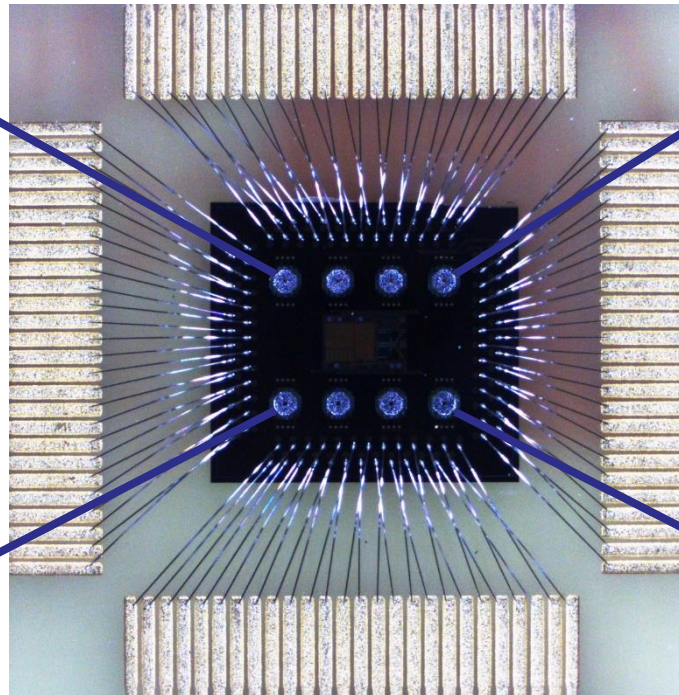
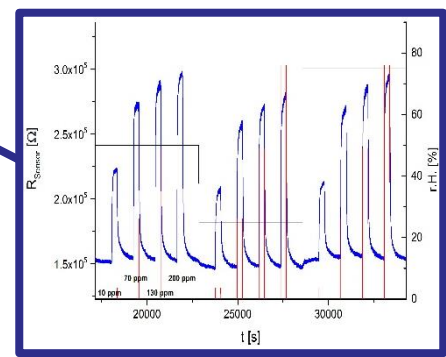
## CuO-NW



## SnO<sub>2</sub> + Pt



## CuO + Au



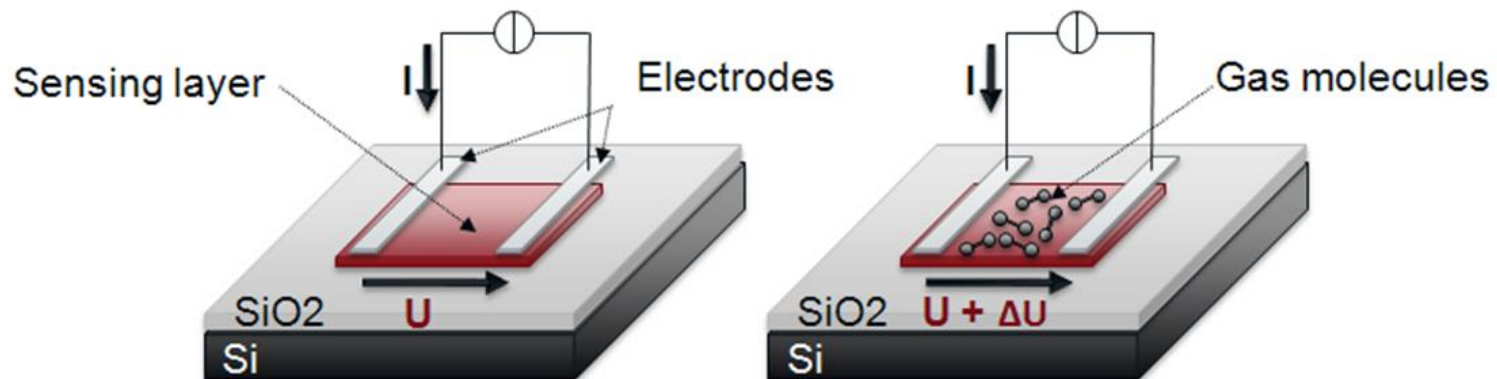
Source: Anton Köck, MCL

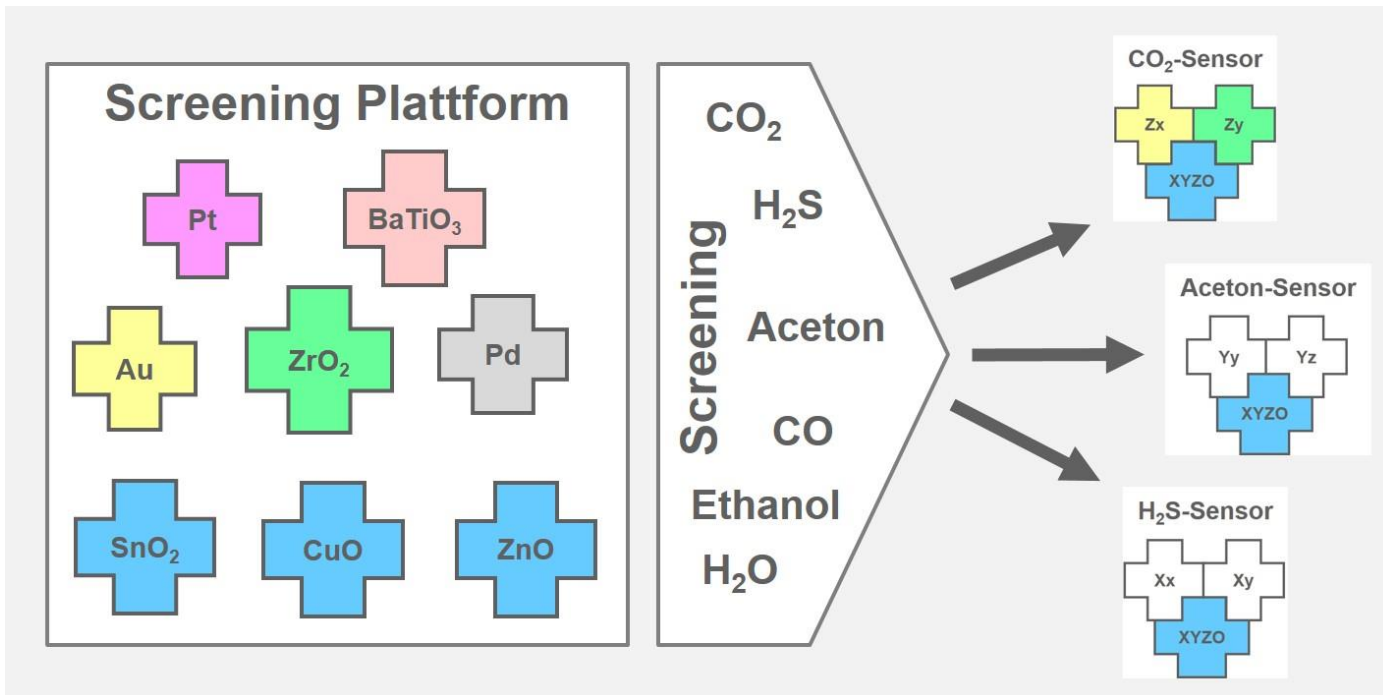
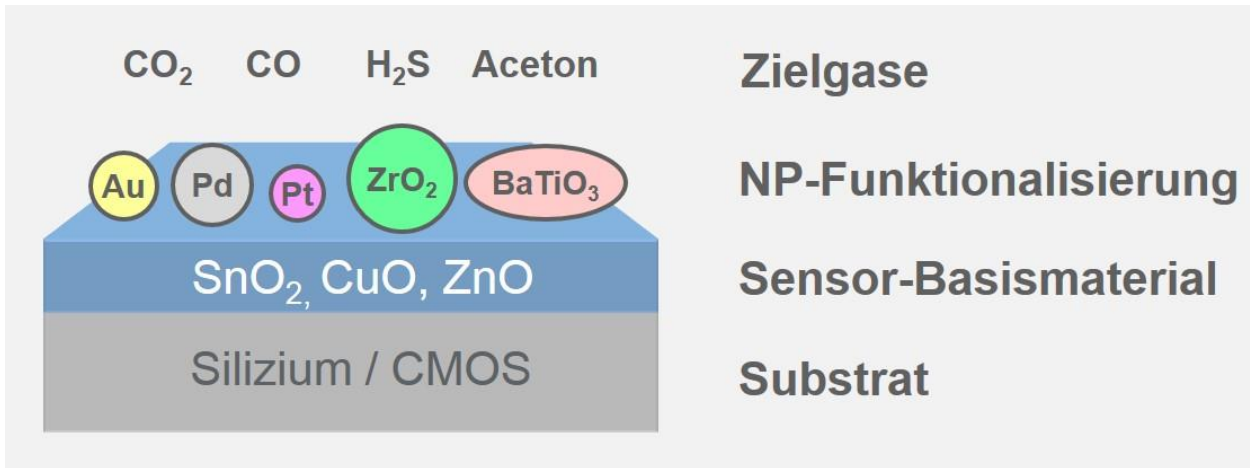
## Thin film & nanowire sensors & nanoparticles

- SnO<sub>2</sub>-thin films
- SnO<sub>2</sub>-NWs
- CuO-NWs
- ZnO-NWs
- WO<sub>3</sub>-NWs

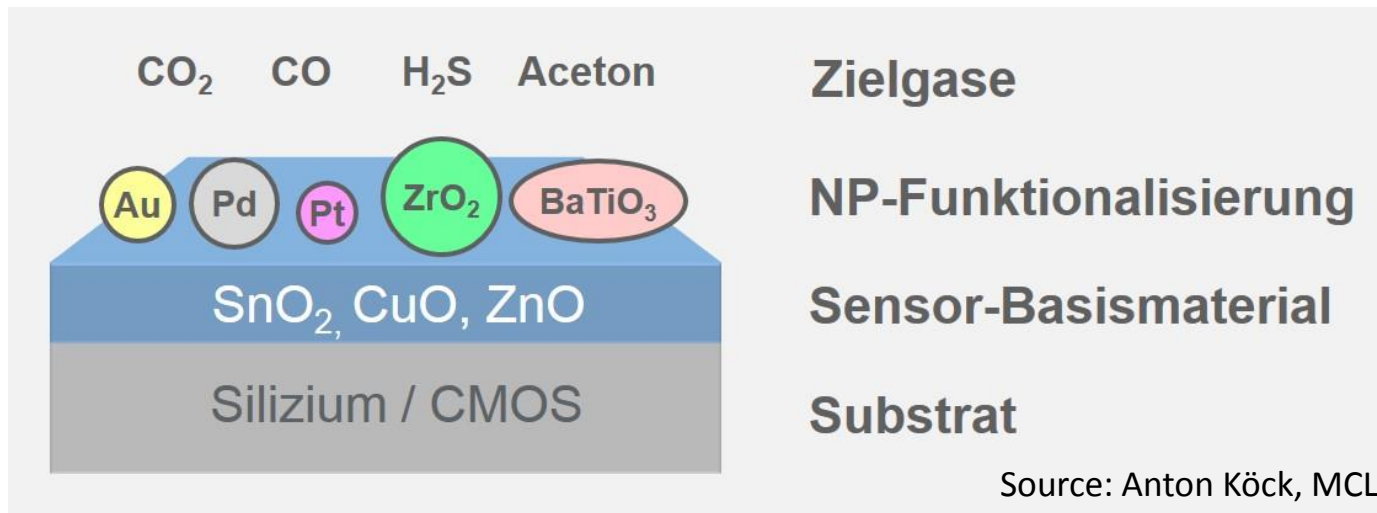
- Au, Pt, Pd
- AuPd, PdPt,...
- ZrO<sub>2</sub>
- BaTiO<sub>3</sub>

Target gases:  
CO, CO<sub>2</sub>, VOCs,  
H<sub>2</sub>, H<sub>2</sub>S, O<sub>3</sub> and  
NO<sub>2</sub> in  
dry & humid air









Which combination of

- Sensor material
- Functional nanoparticle
- Nanoparticle 1 + nanoparticle 2 + .....
- Size of nanoparticles and surface density....

to achieve the best sensor for specific target gas ???

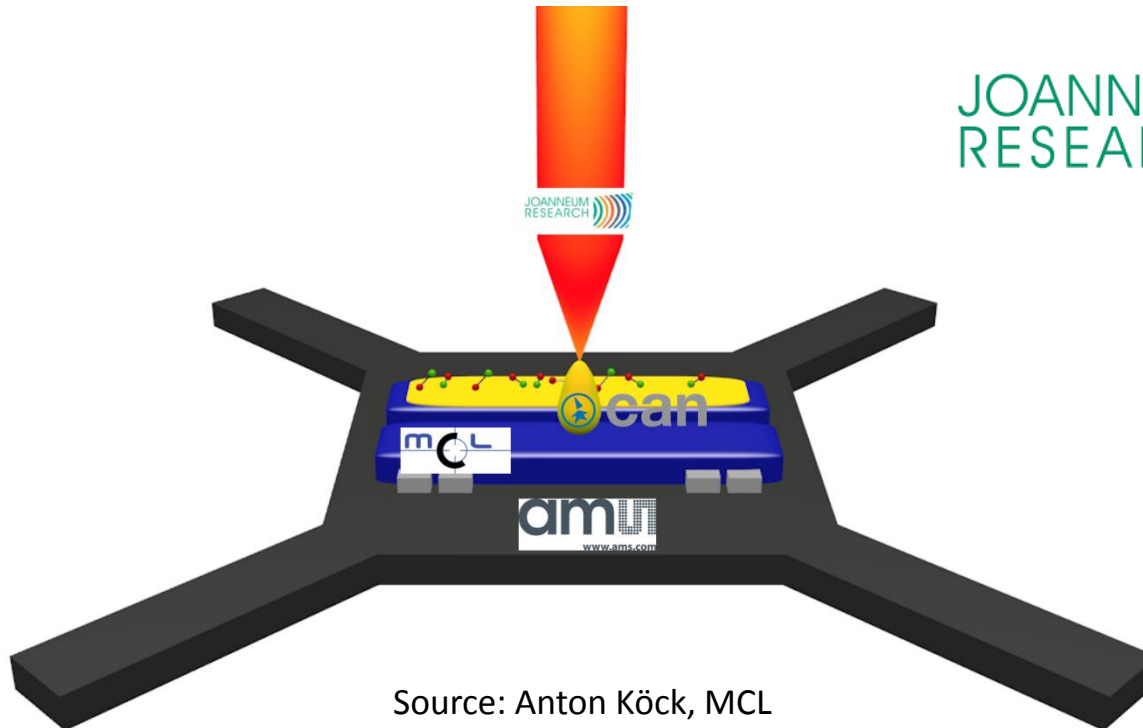
# FunkyNano-Project



- MCL: sensor fabrication (metal oxides)
- AMS: fabrication of (CMOS) platform chip
- CAN: fabrication of nanoparticles
- JR: ink-jetting of nanoparticles



Centrum für Angewandte  
Nanotechnologie



Source: Anton Köck, MCL



**EUROSENSORS**  
XXXII  
**GRAZ 2018**

**save the date**

September 9 - 12, 2018  
Graz, Austria

**32<sup>nd</sup> Conference**

