Motivation I: FH Zweibrücken

- Excellent technical infrastructure (300 m² MST cleanroom for complete process runs) dedicated to education.

- Sustaining the cleanroom requires a minimum size, i.e. a critical mass of personnel and funding:
  - Too much for only education
  Generally financed by research, which then often prevents proper education
Motivation II: Saarland University

- Dept. of Mechatronics with research focus on MST
  - Measurement tech., esp. microsensors
  - Micromechanics, microactuators/-fluidics
  - Materials for MST
  - Medical microtechnology

😊 Excellent theoretical education
😊 International research projects
😊 Limited technology (only for specific process steps)
😊 Limited practical experience for students

Motivation III

- HTW Saarbrücken, FH Aachen
  - Similar to Saarland University

- Research institutes (FhG-IBMT, IMM Mainz)
  - Training of new technicians and research personnel
  - Avoiding costly errors with downtime of critical equipment

- Companies (HYDAC, thinXXS)
  - Training of personnel
  - Cooperation in development with new processes

❗ All need more students, technicians and researchers
Partners:
- 4 Universities
- 2 R&D-institutes
- 2 Companies
- 4 Pilot-schools

From 3 federal states:
- Rheinland-Pfalz
- Saarland
- Nordrhein-Westfalen

Education is state responsibility!

The Network pro-mst
http://www.pro-mst.de

pro-mst goals and activities

- Cooperation in education and research
  - joint effort in developing courses and training materials
  - joint definition of research projects
- Cooperation in financing the clean room used by all
- Joint PR activities in schools to increase interest in MST and technical disciplines in general
- **Ultimately:** Strengthening the economic competitiveness of the region Westpfalz/Saarland (still depending on coal and steel)
Examples for cooperation with schools

- MST introductory courses for teachers
  - Introduction to MST technologies, components and applications
  - MST-examples and experiments for use in classes (physics, tech)

- MST workshops in the cleanroom
  - Photolithography
  - Microstructure characterization

- Support of school projects
  - Sensors for a wind tunnel
  - Go-kart with micro-sensors

Examples for cooperation in education

- Hands-on courses in the cleanroom in Zweibrücken for students from Saarland University
  - **Prerequisite:** courses in MST supplied by home university
  - **Preparation:** 3-day block course using the Virtual Cleanroom tools developed in the project ing-media (presented by A. Picard)
  - **Five day hands-on course** in Zweibrücken: complete process run for a simple pressure sensor (4 mask layers) from wafer preparation to sensor characterization
  - **Staffed from both** Zweibrücken and Saarland University
Pressure sensor prepared in lab project

4 piezo-resistive strain gauges in Si-membrane (bridge configuration)

Si-chip with micromachined membrane (back-side etch)

Al leads and bondpads ("sputtered thin film")

Packaging: Si-chip bonded to glass carrier ("Anodic bonding")

4 piezo-resistive strain gauges in Si-membrane (bridge configuration)

"Simple" pressure sensor: more than 100 process steps
The Future I: Cooperation with other Universities

- Courses offered to Higher Education Institutions
  - Nationally and internationally
  - Course program developed cooperatively adapted to education requirements of home university
  - Cost participation based on clean room and personnel costs necessary: 15 k€ for 5-day course for 12 participants

- R&D project support to realize own designs
  - Multi-project wafers with standardized process for education
  - Lower cost than foundry process for use in project groups

- Extension of cooperation to other technology fields?

The Future II: Commercial hands-on courses

- Course program making use of
  - Technical infrastructure (i.e. cleanroom, test equipment etc.)
  - Know-how available through the partners
  - Aim: supplementing University funding for the cleanroom

- Advantage for companies and R&D institutes
  - Training of new staff without interrupting production
  - Preventing operating errors resulting in equipment downtime

- Standard courses

- User defined courses for specific requirements, i.e. regular training of new staff for companies
Commercial courses: example I

Cleanroom techn. and correct cleanroom behavior

- 2-day course
  - **Lectures**
    - Cleanroom technology, equipment and clothing
    - Cleanroom behavior
    - Measurement technology for cleanroom characterization
  - **Hands-on modules**
    - Correct clothing and behavior in the cleanroom
    - Use of cleanroom equipment

- Maximum 12 participants
- Cost: approx. 700 € per participant

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Commercial courses: example II

MST technologies, components and applications

- 3-day course with hands-on modules
  - **Lectures** giving an introduction
    - Microtechnologies (lithography, thin-film technology) and equipment, characterisation and testing
    - Microcomponents, -sensors, -actuators and systems
    - MST applications
  - **Hands-on modules**
    - Lithography
    - Thin-film deposition
    - Sensor characterization

- Max. 9 participants, approx. 1200 € per participant
Conclusions

- New approach for sharing of precious resources: 
  Partnership in education and research
- Example for public private partnership
- Applicable not only to MST
- Solutions for financing across state borders required

Please contact us for course requests/requirements

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