MICROPRINCE

OPEN ACCESS FOUNDRY PILOT LINE FOR ELASTOMER ASSISTED MICRO-ASSEMBLY

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Agenda

- What is Micro-Transfer-Printing?
- MICROPRINCE - Pilot Line for Micro-Transfer-Printing
- Optimization of Tether Design and Release Etch
- Current Application Scenarios
- Summary and Outlook

What is Micro-Transfer-Printing?

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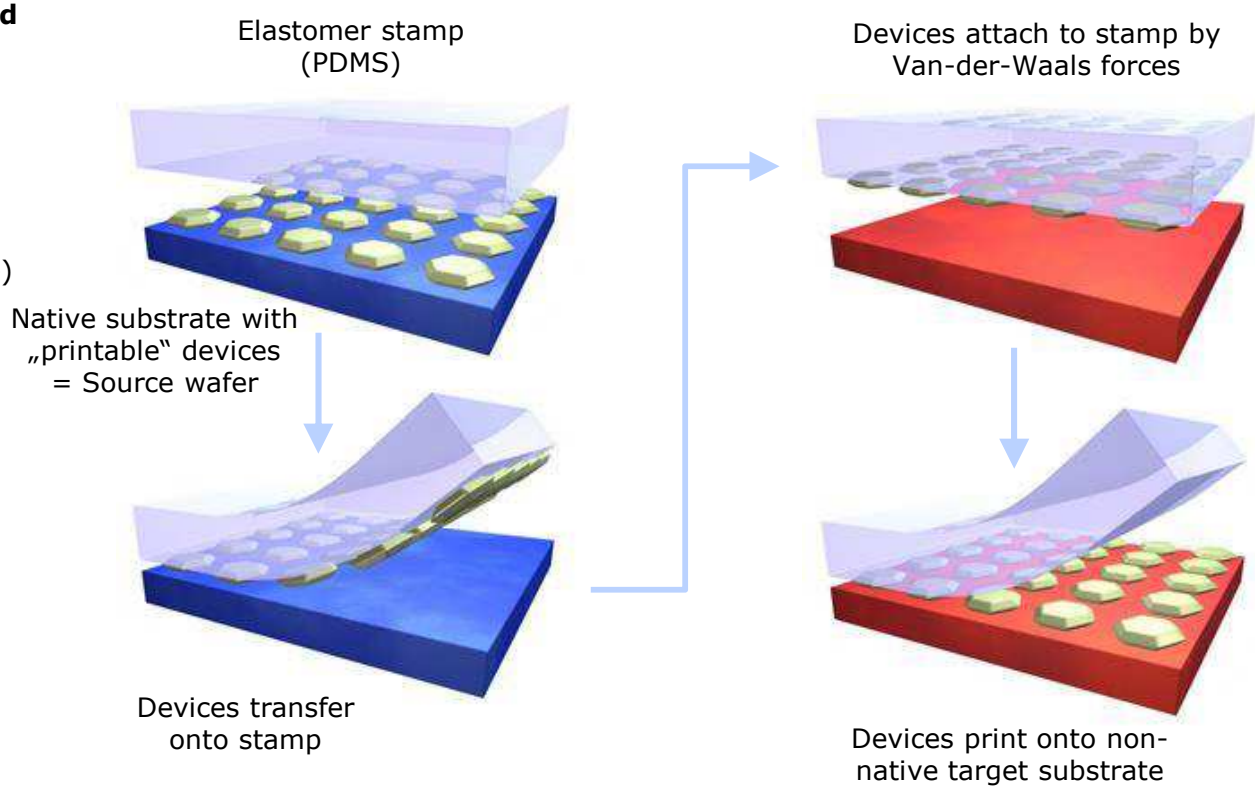
- Approach for heterogeneous integration of microscale electronic devices onto non-native substrates
- Procedure for micro-transfer-printing (µTP):
  1) Release micro-devices on source wafer (wet etch)
  2) Transfer of micro-devices to a target wafer by elastomer stamp (printing)
  3) Forming interconnects

What is Micro-Transfer-Printing?

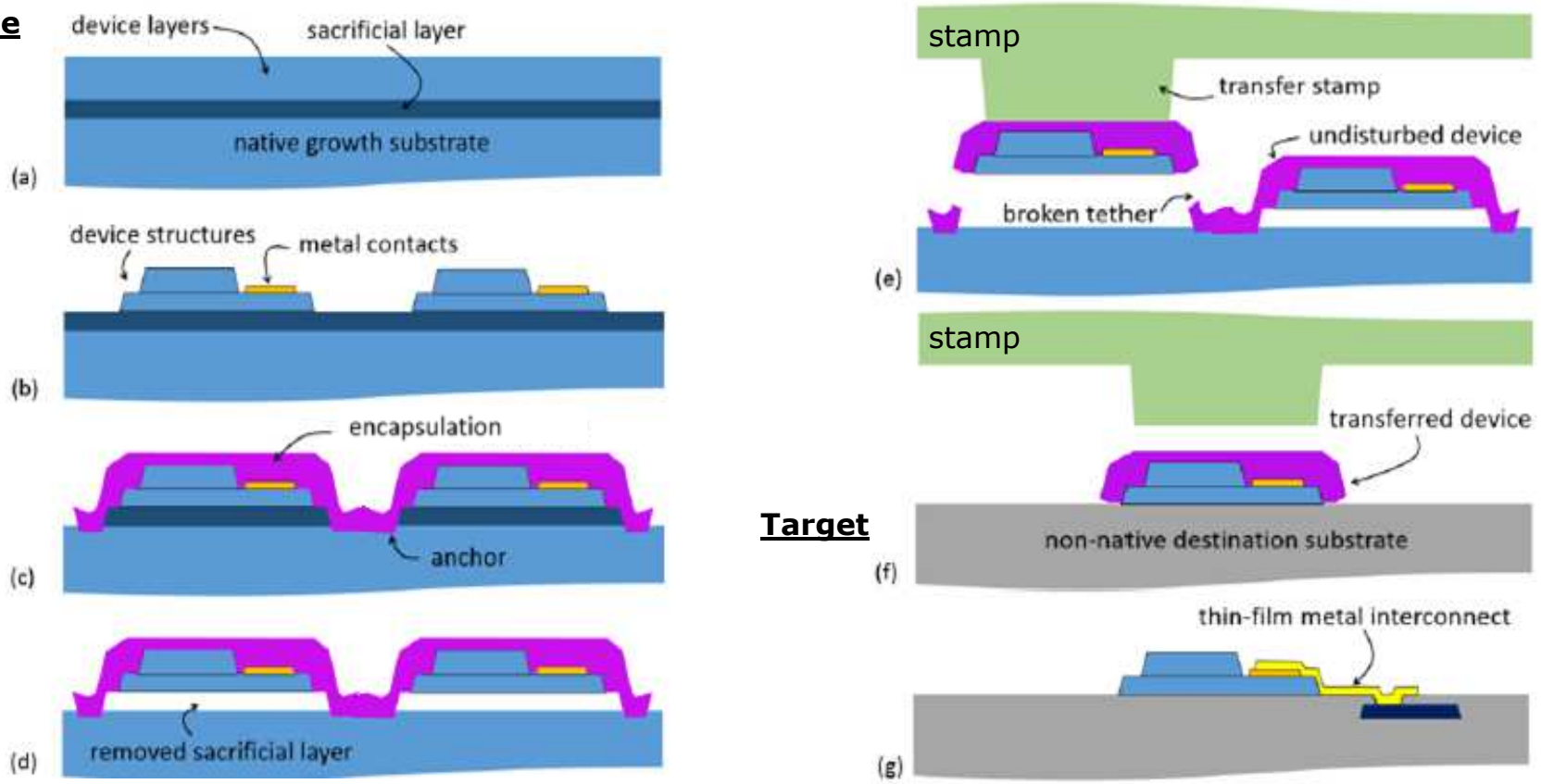
Examples for printed components:

- Optical Filters
- III-V components
- LEDs
- Special sensors
- ICs
- Security envelops (active and passive)
- …



Nature Mater. 5 33-38 (2006)

Technological Process Flow
Principle of Micro-Transfer-Printing



MICROPRINCE - Pilot Line for Micro-Transfer-Printing

MICROPRINCE – Project Description

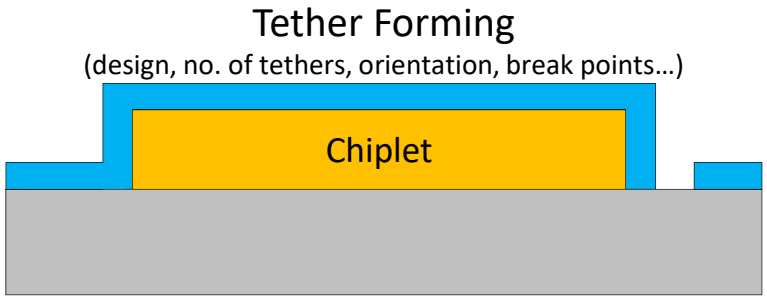
- European funded RnD-project (ECSEL) - www.Microprince.eu
  - Project duration: 04/2017 – 03/2020
  - Consortium consisting of 14 partners in 4 different countries

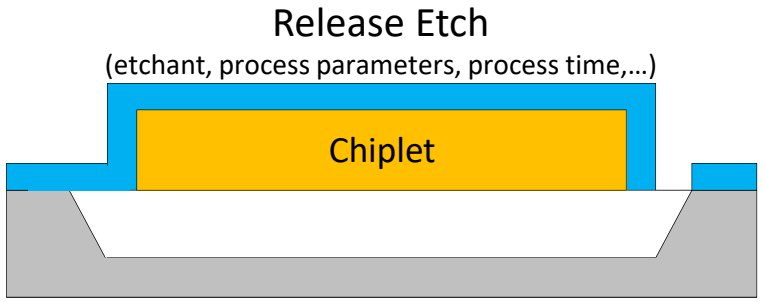
- Creation, installation and demonstration of a pilot line for the µTP in manufacturing environment for open access - in MEMS-Fab Erfurt, Germany
- Development of design rules (DR) and its implementation in Process-Design-Kits (PDK)
- Process transfer of five defined target applications for magnetic sensors, optical sensors and light / laser sources
- Upscale from laboratory environment to industrial manufacturing

Optimization of Tether Design and Release Etch

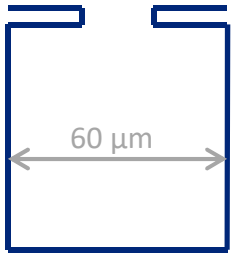
Optimization of Tether Design and Release Etch

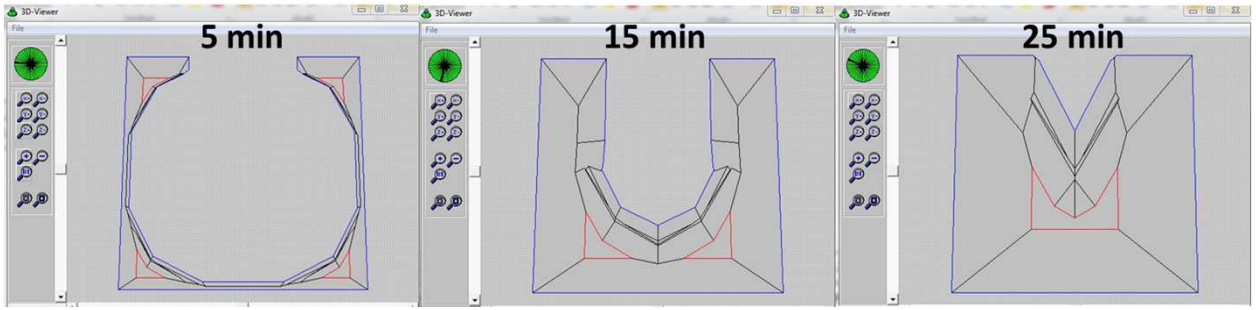
- Release of chiplets by wet-chemical processes (etchant: KOH, TMAH)
- Process realization on production tools and environment
- Balance of tether strength - high strength (etching) and low strength (printing)
- High yield of printing



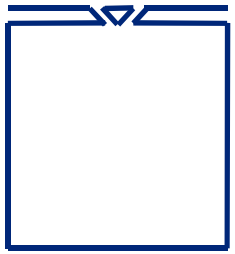


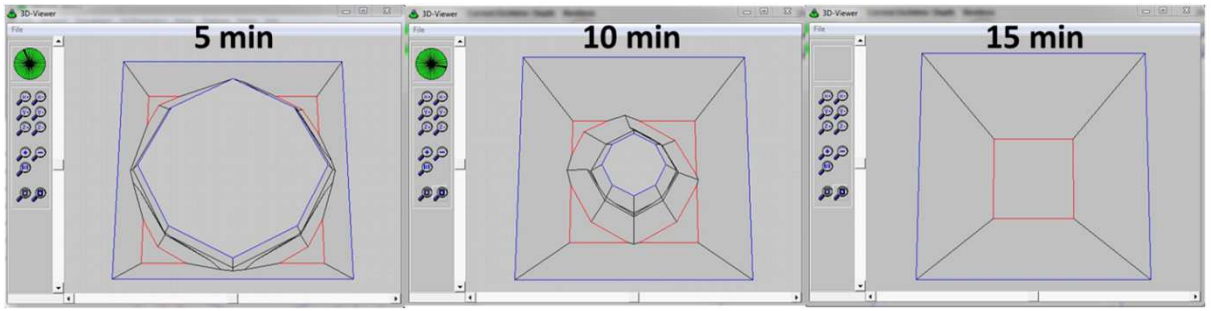
Optimization of Tether Design and Release Etch





Release after
35 min





Release after
15 min

Current Application Scenarios

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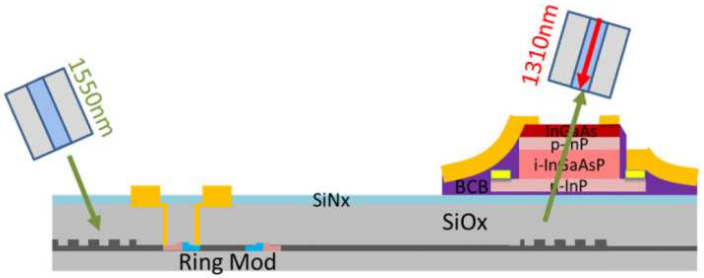
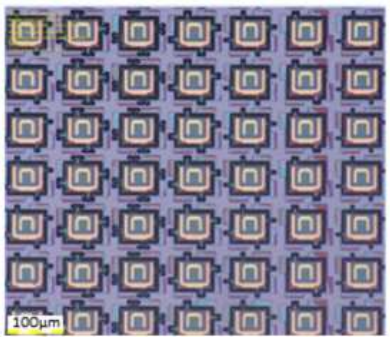
- **Optical Filters**
- **Silicon Photonics**
- **Printing for magnetic sensors**
- **Printed LED (e.g. automotive applications)**
- **… and many more**

Application for Silicon Photonics

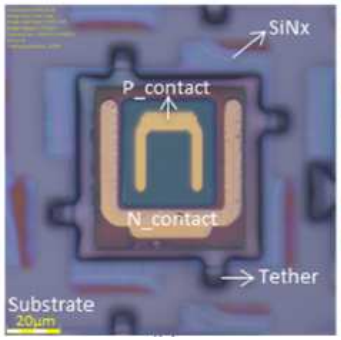
- ZHANG et al., OPTICS EXPRESS 14290, Vol. 25, No. 35

  Schematic cross-section of tansceiver

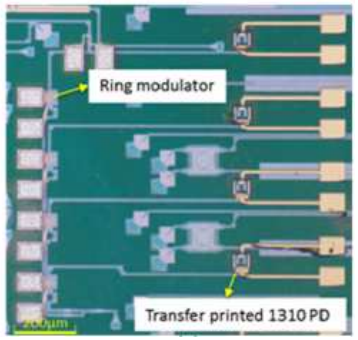




Source wafer



Chiplet



Target wafer

Summary and Outlook

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- µTP is unique approach for heterogeneous device integration
- Challenge: process and technology transfer to industrial manufacturing
- Process development for preparation of Si-based wafers and III-V material ongoing
- Planned availability of MICROPRINCE pilot line in Q3/2018
- Many thanks to EU for funding and all partners

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Thank you for your attention!

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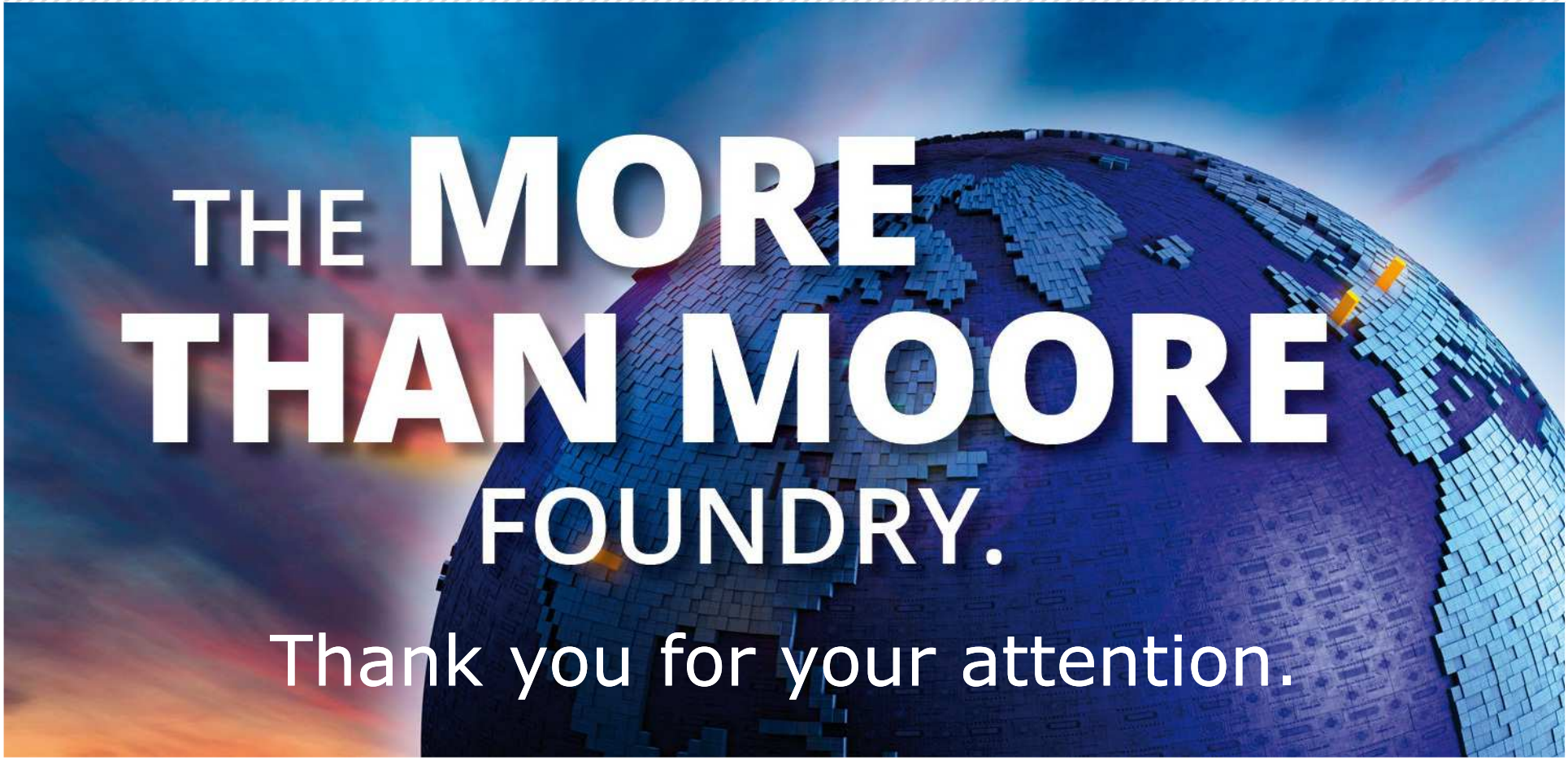
MICRO PRINCE
FAB
THE MORE THAN MOORE FOUNDRY.
Thank you for your attention.