

# PhotonHub Demo Centre

Thick-SOI photonics for sensing and imaging

## Course Provider

VTT Technical Research Centre of Finland Ltd.,  
Finland

# Course Overview

Photonic integrated circuits (PICs) can be realized on many different technology platforms and used for numerous different applications. This course focuses on the so-called Thick-SOI platform and its use for sensing and imaging applications in the near and mid-infrared region. Primary focus is on 3  $\mu\text{m}$  thick silicon-on-insulator (SOI) waveguide technology, since this 3  $\mu\text{m}$  SOI platform has offered open-access multi-project wafer (MPW) runs via ePIXfab and VTT for several years. This platform is also available for small-to-large volume contract manufacturing via VTT and Rockley Photonics. Process design kits are available in multiple PIC design software platforms.

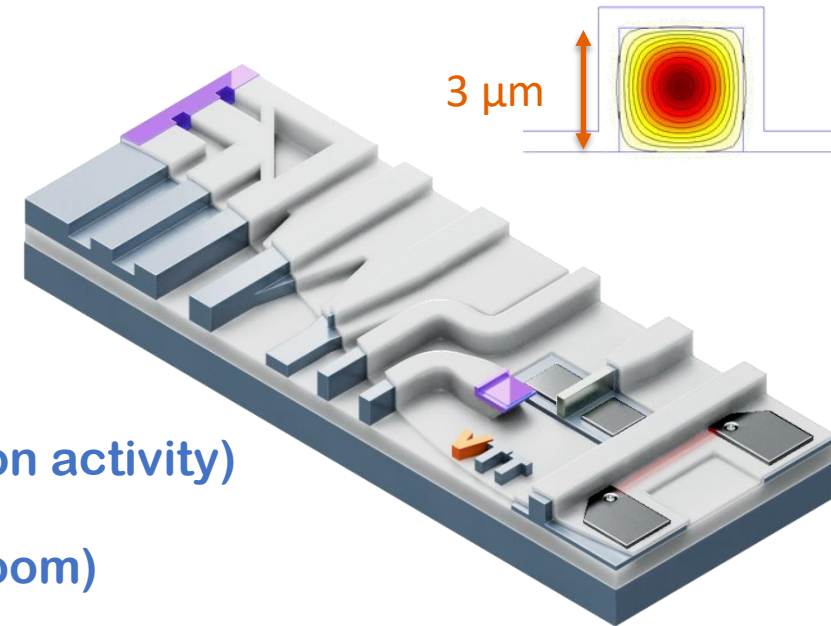
This one-day hands-on training course provides industry an overview of the Thick-SOI PIC platform and its feasibility in sensing and imaging applications. A clean room tour in Micronova offers an overview of the used fabrication methods and facilities. Hands-on training includes 1) the design of 3  $\mu\text{m}$  SOI PICs using PIC design software, 2) wafer-level testing (WLT) in the clean room and 3) PIC testing in the photonics measurement lab. The last part includes semi-automated fiber-to-waveguide alignment, optical beam steering with an optical phased array (OPA) and one sensing demonstration that vary from training to training and may include e.g. Faraday rotation in SOI waveguides or gas sensing with a tunable light source.

# Target Audience

It is desirable but not essential that course attendees have a basic understanding of photonics. The course is ideally suited to those planning to develop new photonic products based on low-loss photonic integrated circuits (PICs) operating within the 1.2-6  $\mu\text{m}$  wavelength range where the thick ( $\mu\text{m}$ -scale) silicon-on-insulator (SOI) waveguides can operate.

## Expected Outcomes

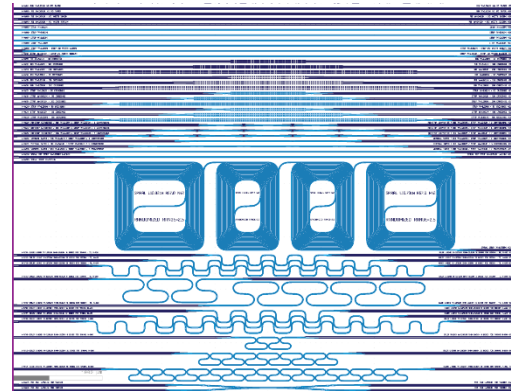
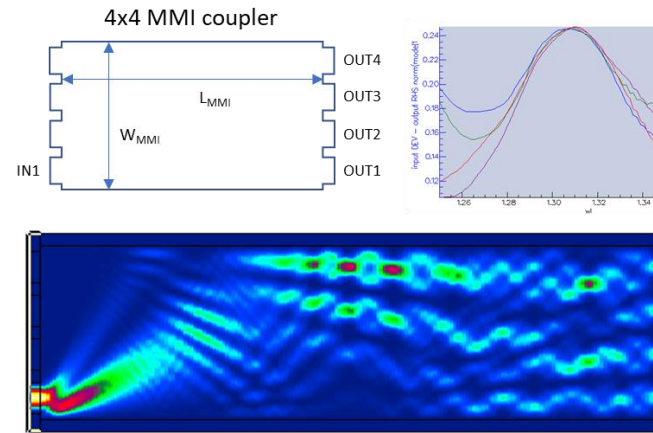
- 1) Understanding the technical advantages and limitations of Thick-SOI PIC technology, as well as its key applications
- 2) Learn how the Thick-SOI PICs are designed & simulated (hands-on activity)
- 3) See the fabrication process of 3  $\mu\text{m}$  SOI PICs (visit to the clean room)
- 4) Learn how the Thick-SOI PICs are tested at wafer and chip-level (hands-on activity)
- 5) See demonstrations of 3  $\mu\text{m}$  SOI PICs in sensing and imaging applications (hands-on activity)



# Course Schedule

Time	Demo Activity
09:00 – 10:45	Introduction to the course, to Thick-SOI technology and its main applications
11:00 – 12:30	Demo 1: Design of 3 $\mu\text{m}$ SOI PICs using a process design kit (hands-on)
13:30 – 15:00	Demo 2: Clean-room visit to see fabrication flow and wafer-level testing (hands-on)
15:15 – 17:00	Demo 3: Chip-level testing and demonstration of Thick-SOI in sensing & imaging (hands-on)
17:00 – 17:30	Follow-Up Questions & Close

# Course Trainers



**Course Director: Timo Aalto**

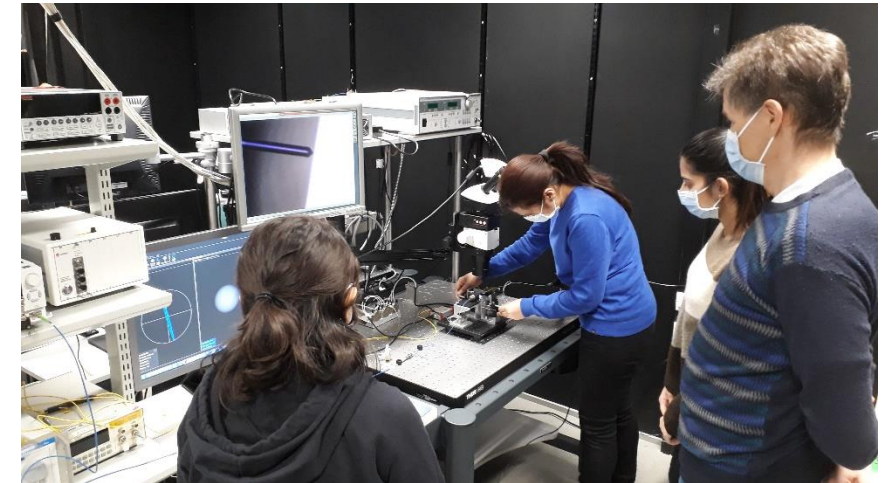
**Course Manager: Srivathsa Bhat**

**Demo 1: Mikko Harjanne (PIC design)**

**Demo 2: Fei Sun (clean room visit)**

**Tomi Hassinen (wafer-level testing)**

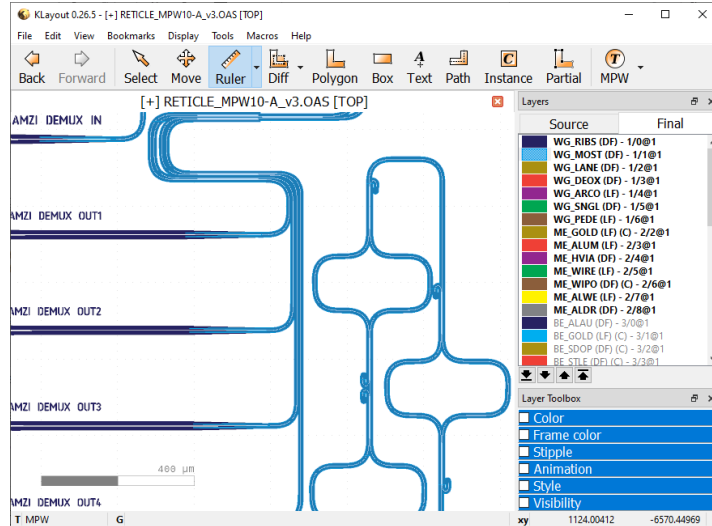
**Demo 3: Yisbel Marin (chip-level testing and application demos)**





# Course Demonstrators

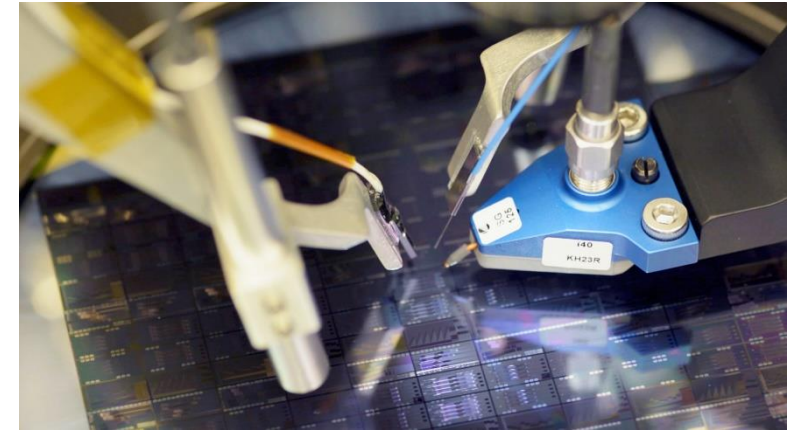
## PIC design demo



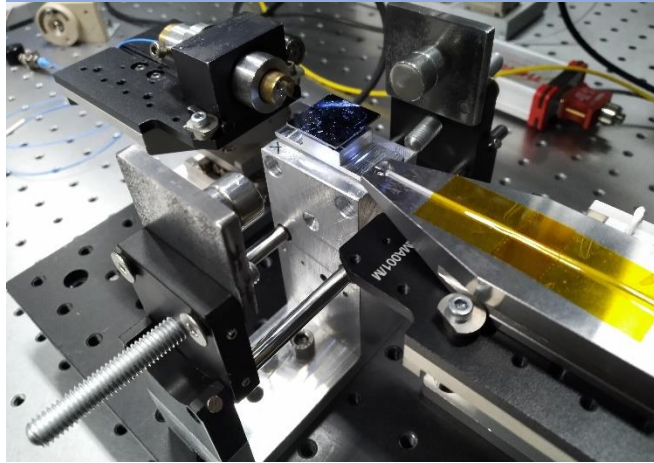
## Clean room tour



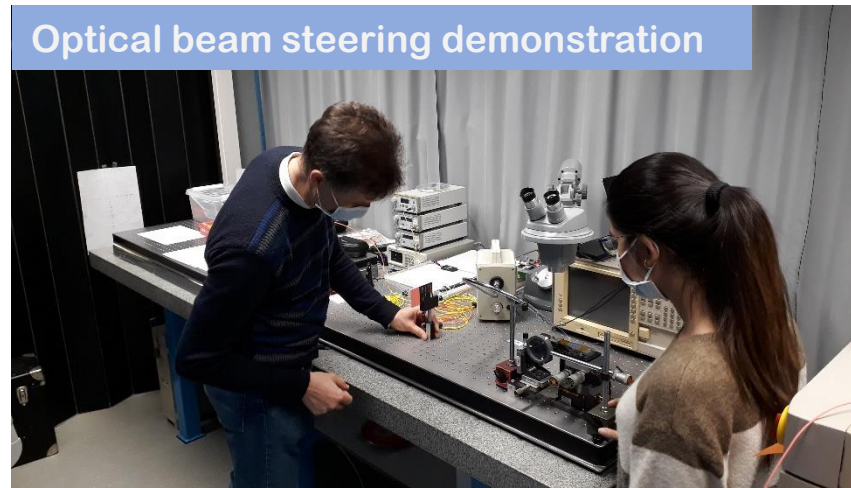
## Wafer-level testing demonstration



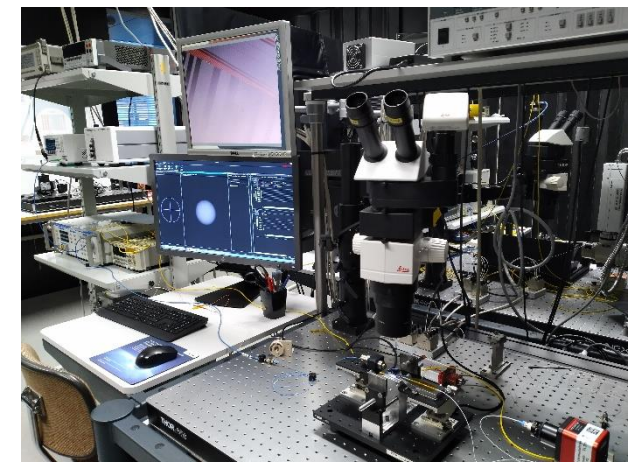
## Fiber-PIC coupling demonstration



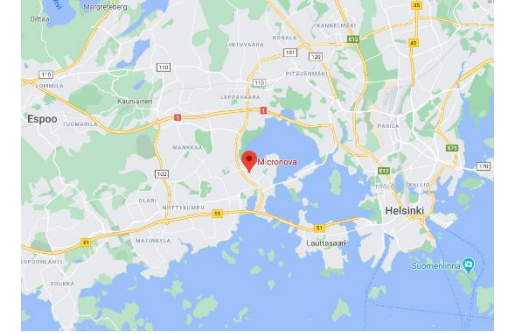
## Optical beam steering demonstration



## PIC sensing demonstration



# Course Location, Schedule & Cost



- Course location: VTT, Micronova, Tietotie 3, Espoo, Finland (few metro stops from downtown Helsinki)
- Course Schedule: 1.9.2021, 16.2.2022 (other dates to be confirmed later)
- Number of people: 10 people per course
- Course Cost: 250 Euros per person, includes catering and project consumables

## Further Information

- [timo.aalto@vtt.fi](mailto:timo.aalto@vtt.fi)
- <https://www.vttresearch.com/en>
- [www.photonhub.eu/euphotonicsacademy](http://www.photonhub.eu/euphotonicsacademy)



# Course Material (technical hand-outs)

## Digital course materials:

- Course instructions and notes
- Copies of slides
- Video recordings
- Process design kit (PDK) for 3  $\mu\text{m}$  SOI PICs  
(requires a signed design kit license agreement)

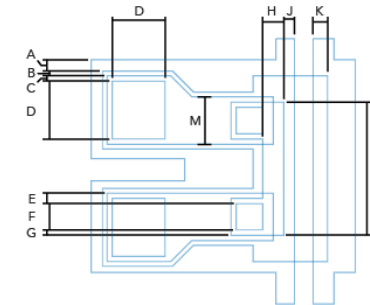


Figure 4.3: Mask parameters for the implanted heater.

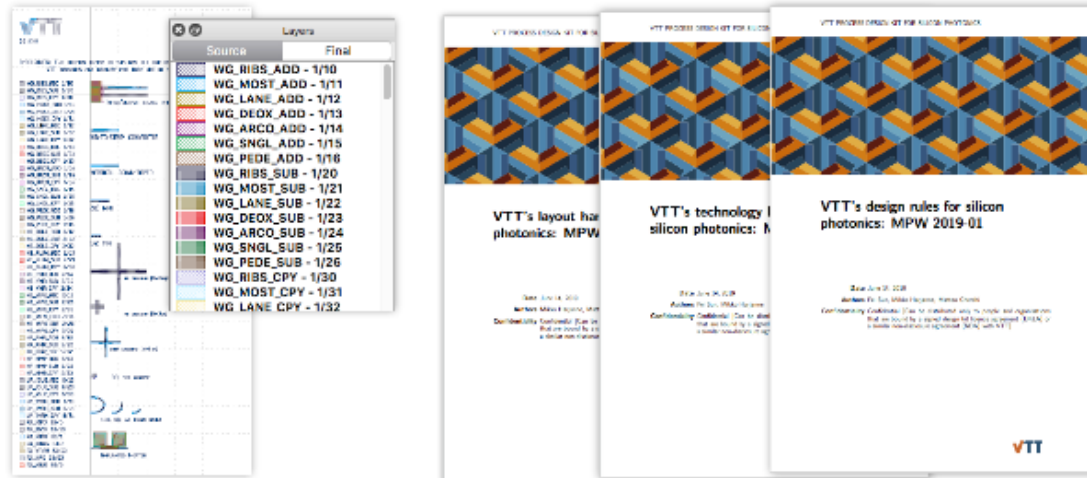


Table 4.1: Parameter values related to Fig. 4.3.

Dimension	Description	Mask layer	Min.	Typical	Unit
A	Gap between wire and SOI sidewall	HE_WIRE	5.0	5.0	um
B	Distance between pedestal edge and metal	WG_PEDE	1.0	...	um
C	Gap between contact pad opening and metal edge	HE_VIPO	3.0	10.0	um
D	Size of contact pad opening	HE_VIPO	60	100.0	um
E	Heater via to wire edge distance	HE_RVIA	3.0	3.0	um
F	Size of heater via opening	HE_RVIA	5.0	5.0	um
G	Heater via to implantation edge distance	HE_RVIA	1.0	1.0	um
H	Implanted heater width	MP_PIMP	3.0	4.0	um
J	Gap between implantation edge and waveguide	MP_PIMP	2.0	2.0	um
K	Pedestal extension past waveguide edge	WG_PEDE	2.0	...	um
L	Implanted heater length	MP_PIMP	...	100.0	um
M	Width of aluminium wire	HE_WIRE	5.0	7.0	um



# Keywords

**Integrated Photonics, PIC, PIC Design, PDK, Silicon-on-Insulator, SOI, Wafer Processing, Sensing, Imaging, Optical Phased Array, Optical Fiber, Laser, Testing, Test automation**

## Relevant Technology & Application Domain

**Technology:** Silicon photonics

**Application:** Relevant to all application domains, but course focuses on sensing and imaging