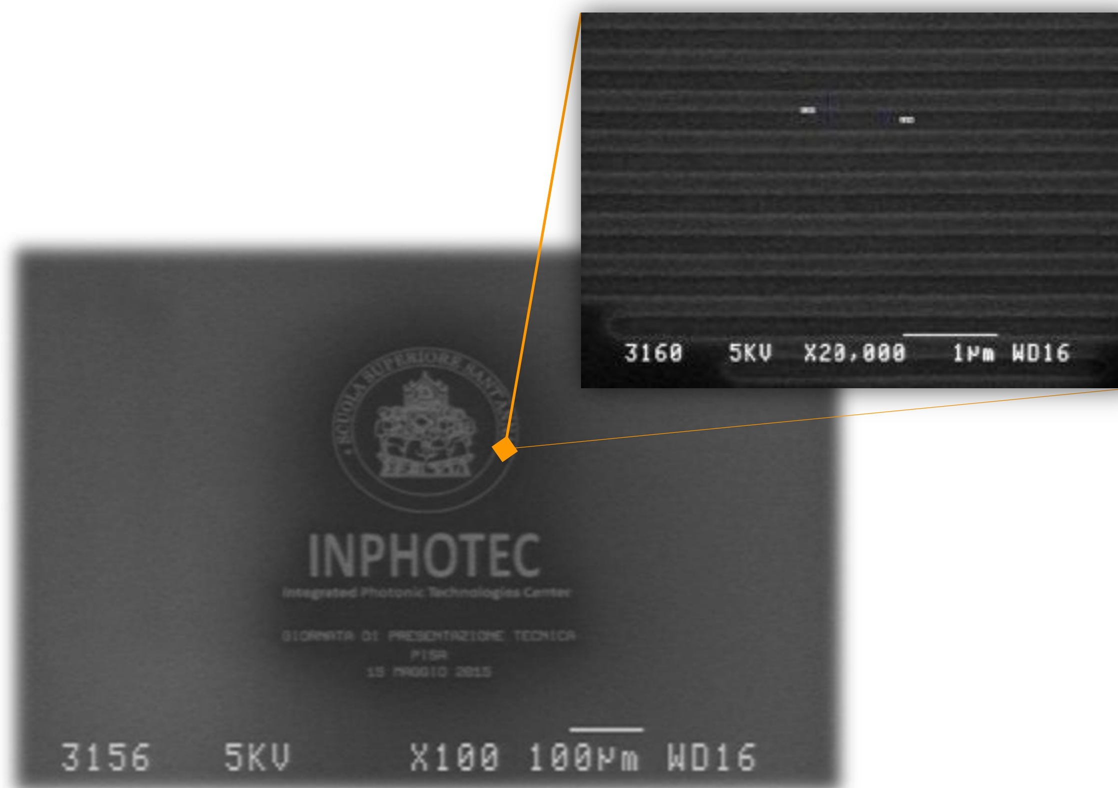
ISTITUTO DI TECNOLOGIE DELLA COMUNICAZIONE, DELL'INFORMAZIONE E DELLA PERCEZIONE
Scuola Superiore Sant'Anna

INPHOTEC
Integrated Photonic Technologies Center

INPHOTEC

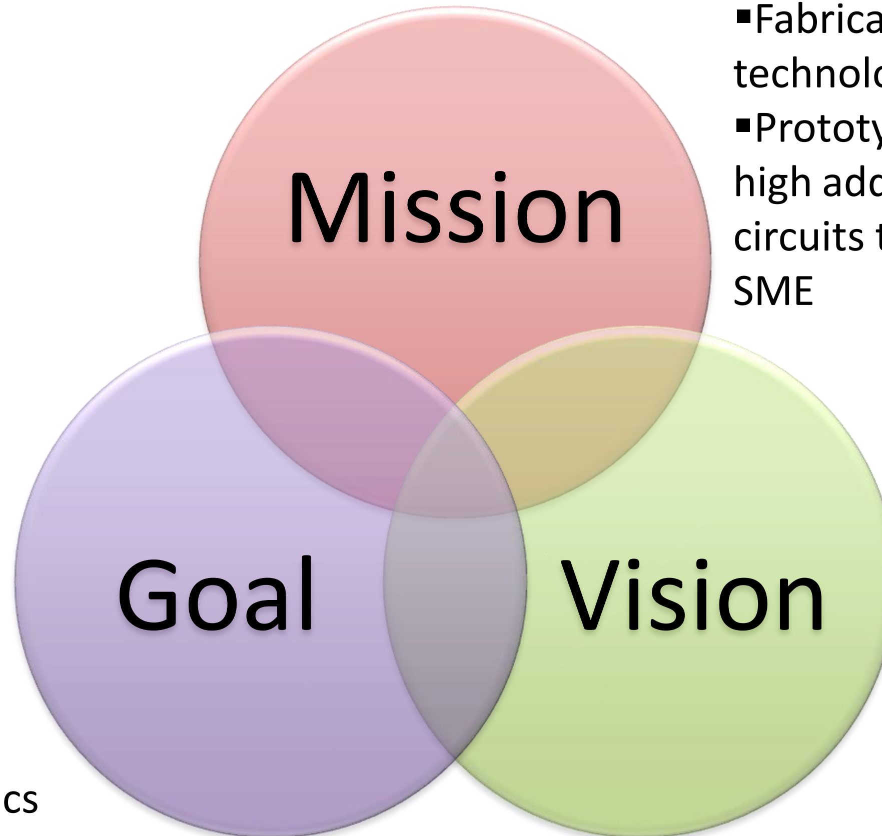
INTEGRATED PHOTONIC TECHNOLOGY CENTER



Vision/Mission/Goal

Mission:

- To provide center of competence
- Fabrication facilities and technologies platforms for research
- Prototyping and production of high added value components and circuits to academic and industrial SME



Goal:

The major areas where INPHOTEC can provide innovative front end and back end processes and technologies are:

- Photonic integrated circuits and optoelectronics
- Bio photonics and medical
- Sensors and MEMS, MOEMS

Vision:

- To create value through innovation developing proprietary solutions
- To have high flexibility and reduced tooling and set-up costs
- To focus on small and medium production level to support industries

ISTITUTO DI TECNOLOGIE DELLA COMUNICAZIONE, DELL'INFORMAZIONE E DELLA PERCEZIONE
Scuola Superiore Sant'Anna

Infrastructure: Clean room

INPHOTEC
Integrated Photonic Technologies Center

Gray area cl
Plasma area cl.1000
LPCVD cl.1000
Metal depo cl.1000
Back end cl.1000
Wet etch cl.1000
Std Litho cl.1000
Ebeam cl.100

Tunnel Bay Design

- Optimizations ratio service area /clean area
- Cross contaminations control
- Technology Up grade low impact

- 490m² Clean Area →
- 25 m² class 100, 190m² class 1000, 275m² class 10000
- 150m² Service Area

ISTITUTO DI TECNOLOGIE DELLA COMUNICAZIONE, DELL'INFORMAZIONE E DELLA PERCEZIONE
Scuola Superiore Sant'Anna

INPHOTEC
Integrated Photonic Technologies Center

Infrastructure: Advanced Packaging Lab

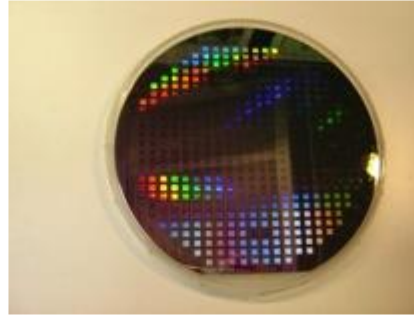
CR: Class 100
T°C 21± 1°C

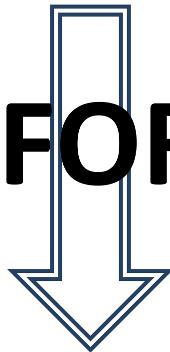
CR: Class 10000
T°C 21± 2°C

Area Blu
3 mt
4.8 mt
5 mt
Laboratorio Elettronica Standard
Ingresso personale
4.5 mt
Assemblaggio Circuiti Elettronici/ottici
9 mt
CDZ
Ingresso attrezzature

Technology Platforms

- Silicon photonics
- Hybrid Integration
- Glass on silicon
- Advanced packaging





FOR

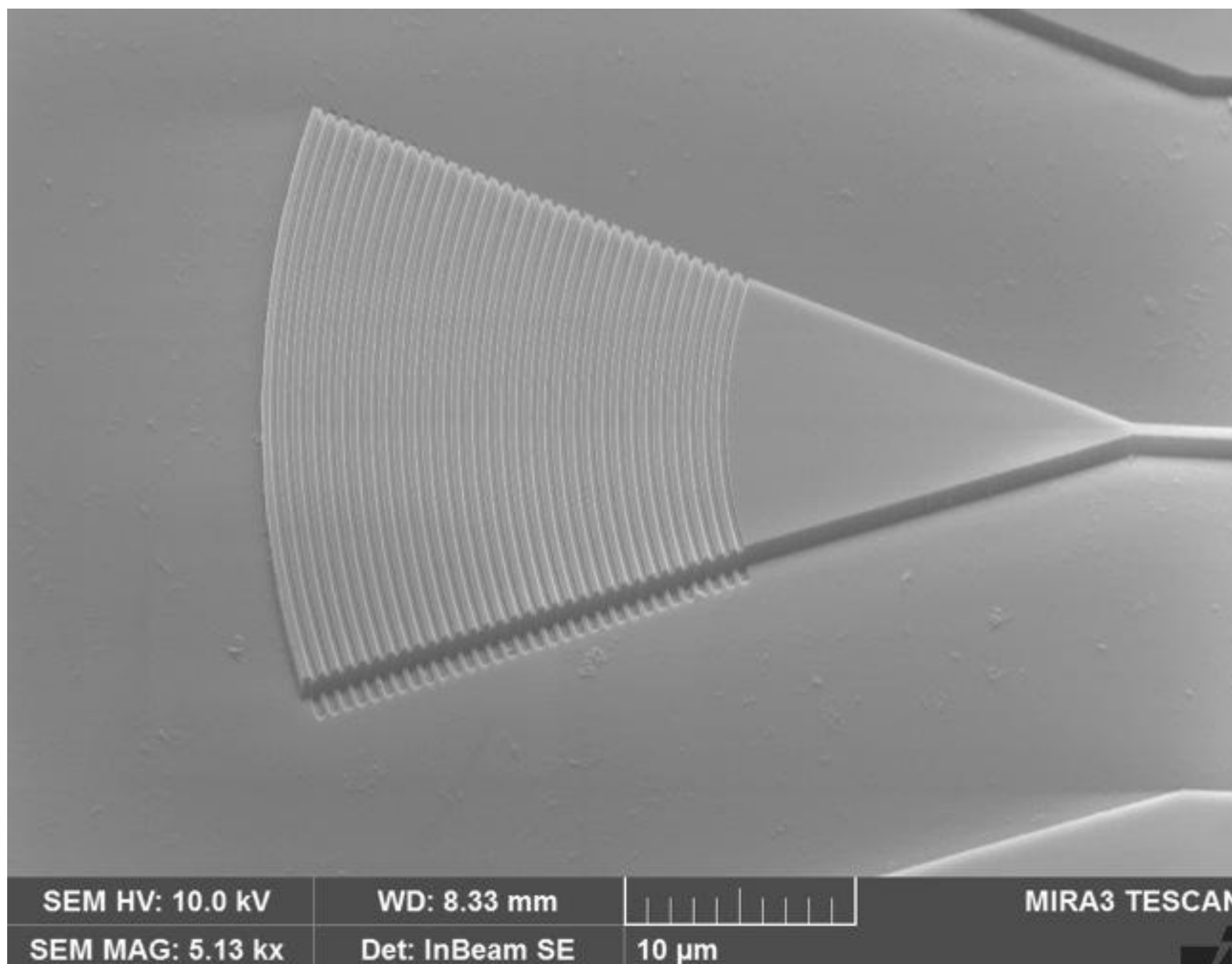
DEVELOPMENT OF PROPRIETARY SOLUTIONS

PROTOTIPATIONS UP TO THOUSANDS PIECES/YEAR

ISTITUTO DI TECNOLOGIE DELLA COMUNICAZIONE, DELL'INFORMAZIONE E DELLA PERCEZIONE
Scuola Superiore Sant'Anna

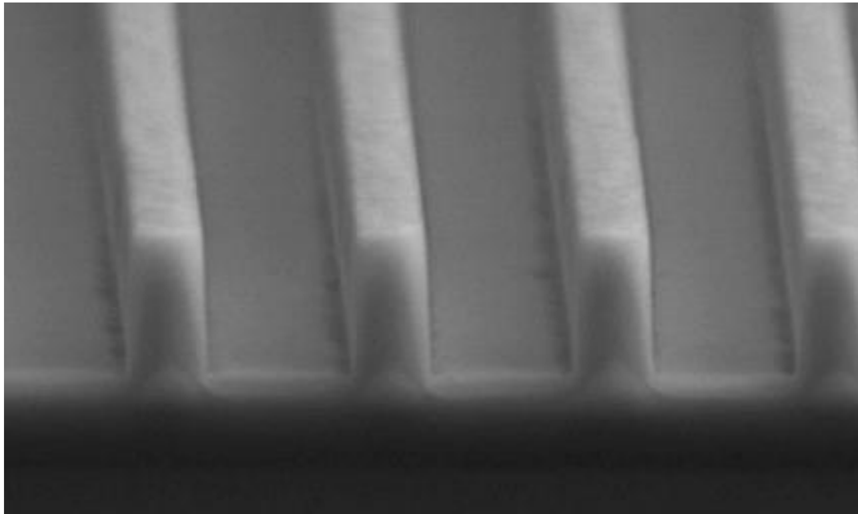
INPHOTEC
Integrated Photonic Technologies Center

Technology Platform Silicon Photonics



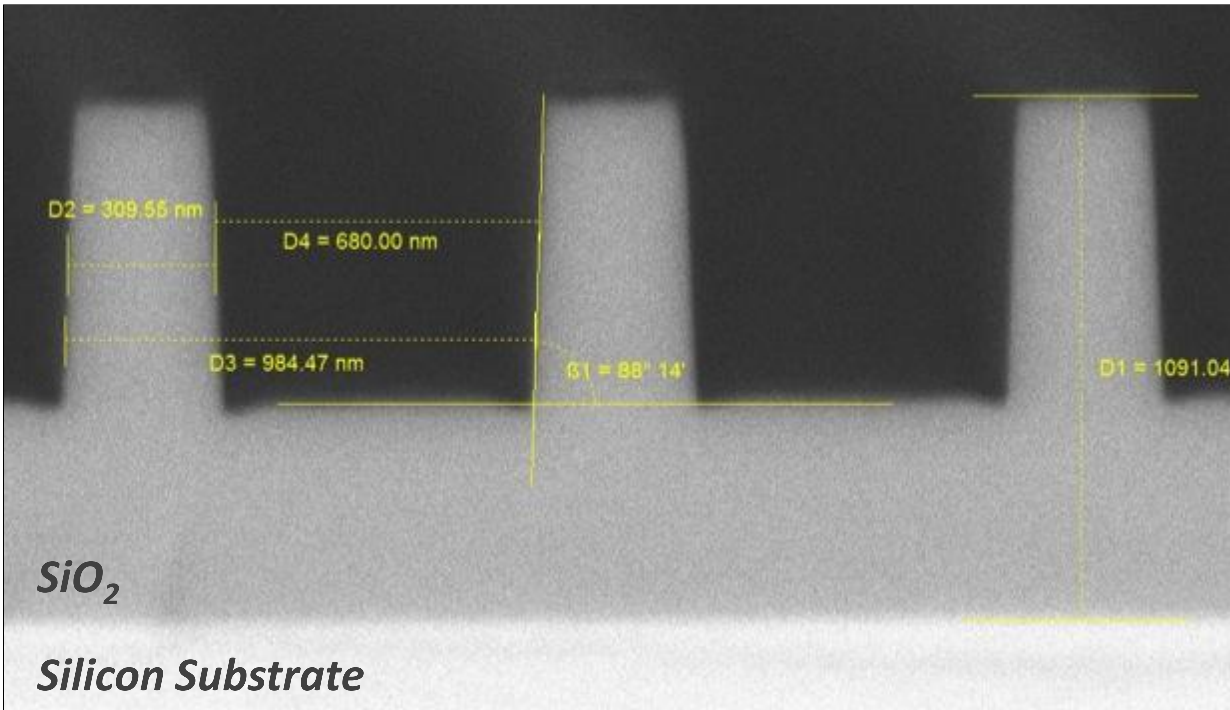
Waveguide Grating coupling Structure for silicon photonics

SUB-MICRON ETCHING OF DIELECTRICS



DEEP ETCHING of PECVD - SiO_2 with Soft Mask (e-Beam)

Etch Depth = 650 nm



Grating Size: 310/680 nm

88° Sidewalls

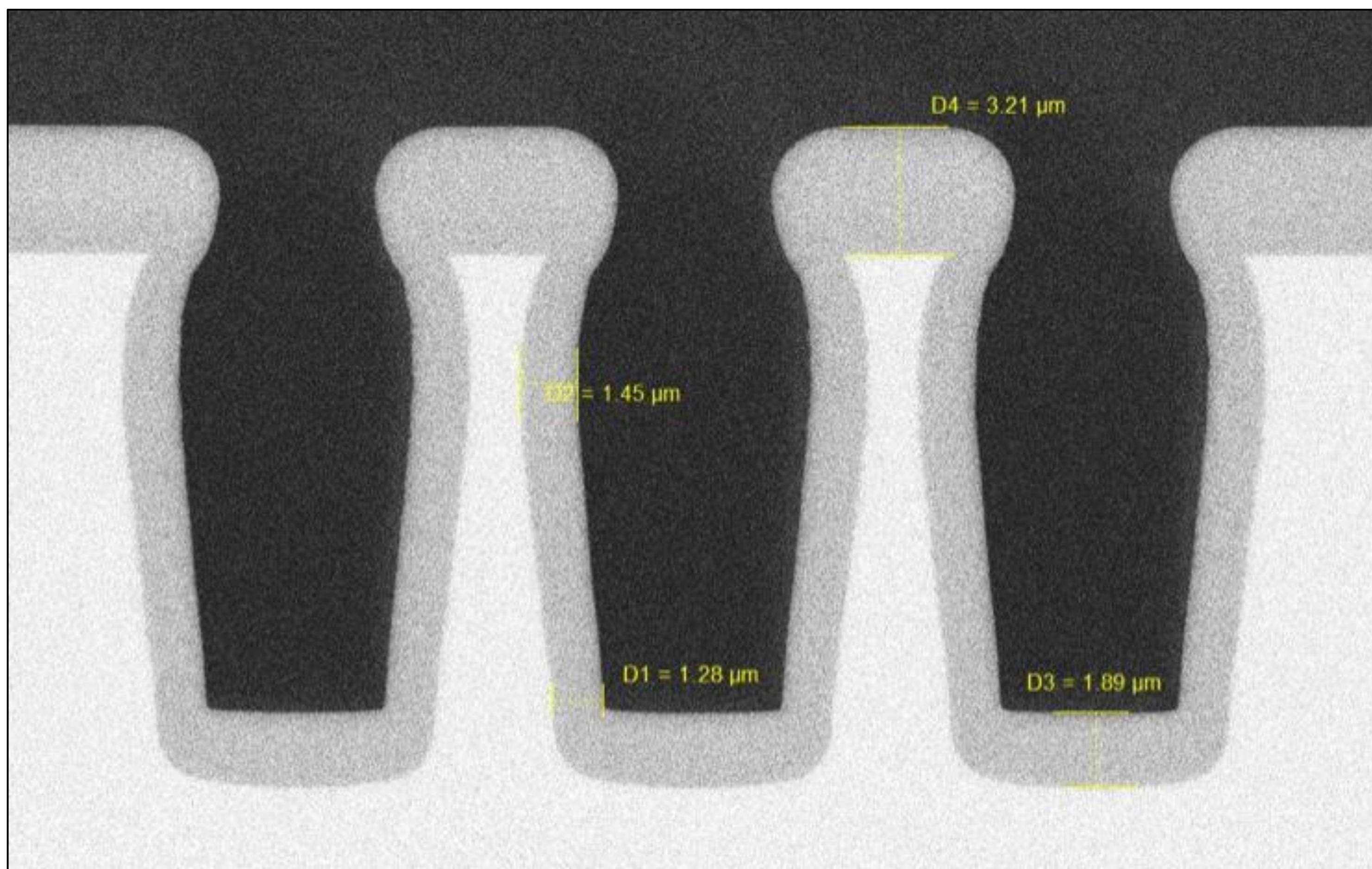
Development in Progress

DEPOSITION OF THICK TEOS BY PECVD

Conformal deposition

PECVD deposition from liquid precursors.

Thick depositions are possible (several microns)



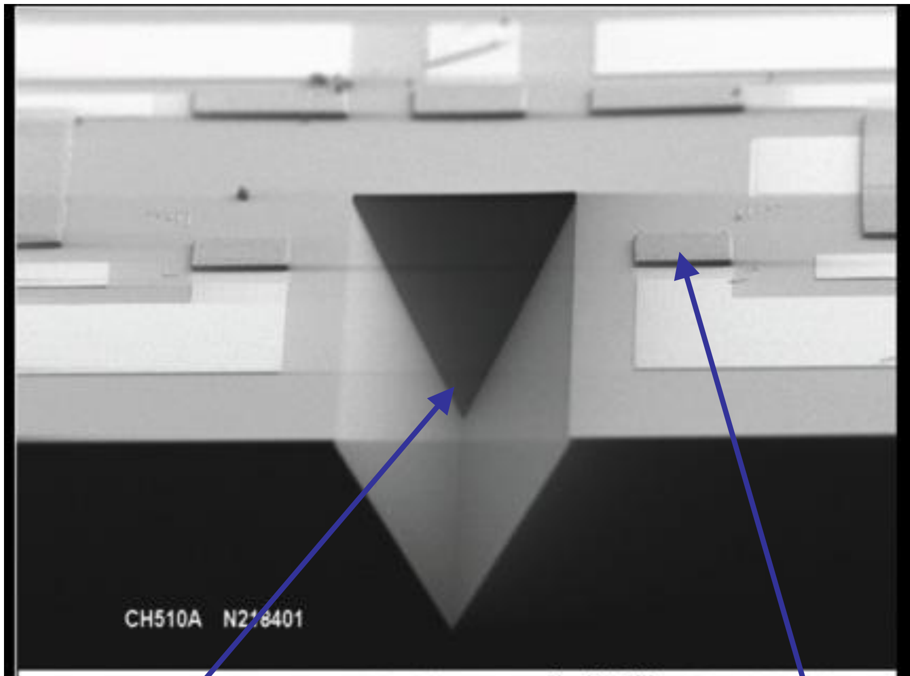
Istituto di Tecnologie della Comunicazione, dell'Informazione e della Percezione — Scuola Superiore Sant'Anna

Technology Platform: Hybrid Integration

INPHOTEC Integrated Photonic Technologies Center

The "Hybrid Integration" Platform aims to develop technologies that can suit the necessity to integrate different devices and parts together, enabling compactness and interoperability.
In particular the Platform will develop the use of micro structured silicon as the SiOB Silicon Optical Bench.

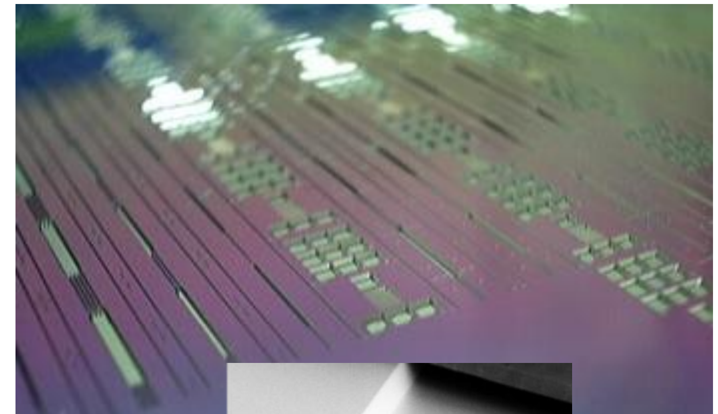
Optical submount

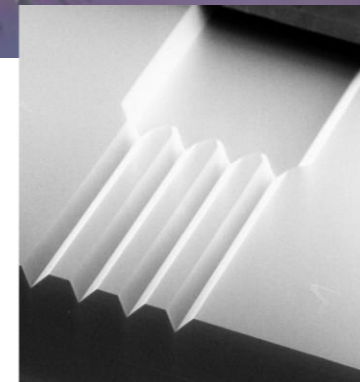


High accuracy 3D structure

Eutectic Alloy metallurgic bonding

Fiber block





Technology Platform: Advanced packaging

ISTITUTO DI TECNOLOGIE DELLA COMUNICAZIONE, DELL'INFORMAZIONE E DELLA PERCEZIONE — Scuola Superiore Sant'Anna

INPHOTEC — Integrated Photonic Technologies Center

Design, development, prototipation, small production packaging line on:

- **silicon photonics and optoelectronics components,**
- **sensors,**
- **MEMS,MOEMS.**

FOR

- **Datacom,**
- **Internet of Things and 5G**
- **Medical**
- **Biotechnology**

ISTITUTO DI TECNOLOGIE DELLA COMUNICAZIONE, DELL'INFORMAZIONE E DELLA PERCEZIONE
Scuola Superiore Sant'Anna

INPHOTEC
Integrated Photonic Technologies Center

MAIN EQUIPMENT

- 1 automatic die-attach FINETECH *PICO*
- 1 manual Wire Bonder TPT model *HB16*
- 1 Automatic ball wire bonder K&S
- 1 Automatic Alignment and Pigtailing Bench
- 1 Splicer FUJIKURA (PM fibers)
- 1 Stereo microscope,
- 1 Chemical Hood, cleaning
- 1 Pull-shear tests XYZTEC model *Condor EZ*

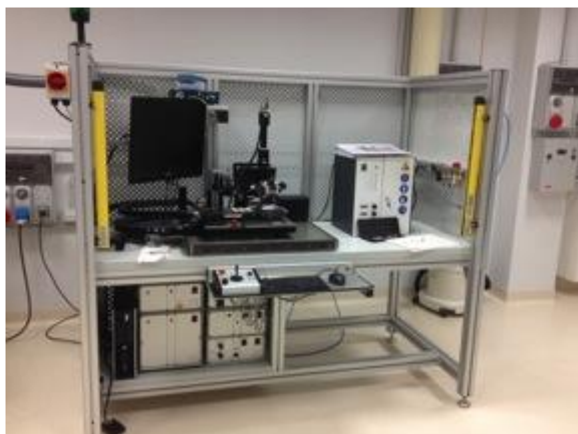
MAIN PROCESSES

- Vertical and horizontal alignment and pigtailing
- Lenses and Fiber Ribbon Alignment and Pigtail
- Die Bonding, Flip-Chip Bonding,
- Tacking, In situ reflow, Eutetic bonding
- Thermocompression
- Single-Step solder ball placement
- Flux less / solder paste / void free soldering
- Wafer bump reflow
- Wire and ribbon bonding

MAIN EQUIPMENT from january 2016

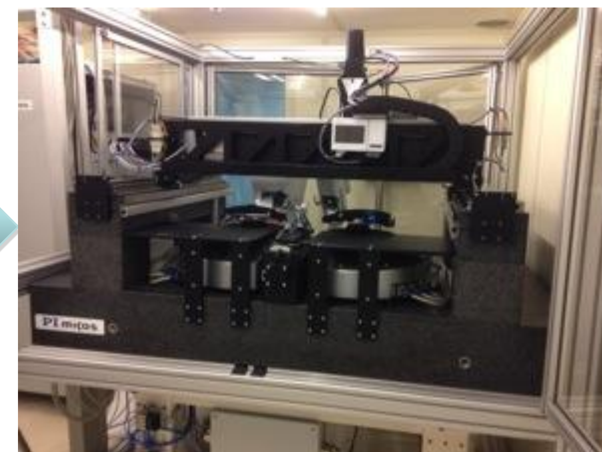
- 1 automatic flip chip machine submicron accuracy
- 1 solder reflow oven with vacuum and reduced atmosphere
- 1 thermal cycling equipment

Technology Platform: Advanced Packaging



Automatic die bonder
Finetech

Automatic ball bonder
K&S



Automatic pigtailing/flip chip bench
PI-miCos

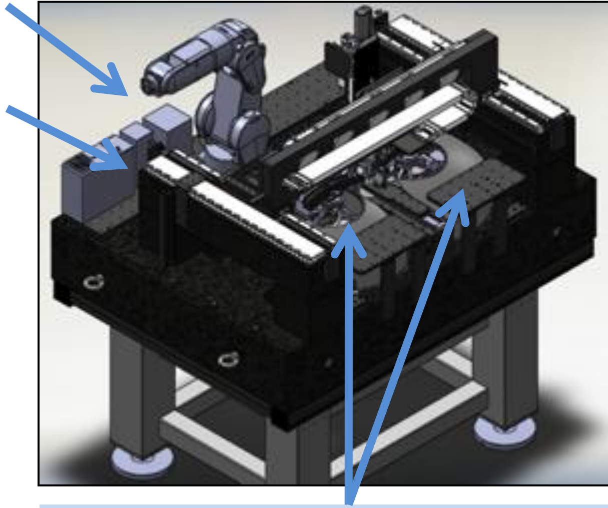
Istituto di Tecnologie della Comunicazione, dell'Informazione e della Percezione
Scuola Superiore Sant'Anna

Automatic alignment bench for Si photonic chips pigtailing

INPHOTEC
Integrated Photonic Technologies Center

Robot

Pick-up station



Submicron precision positioners = SpaceFABs – 6 axis each

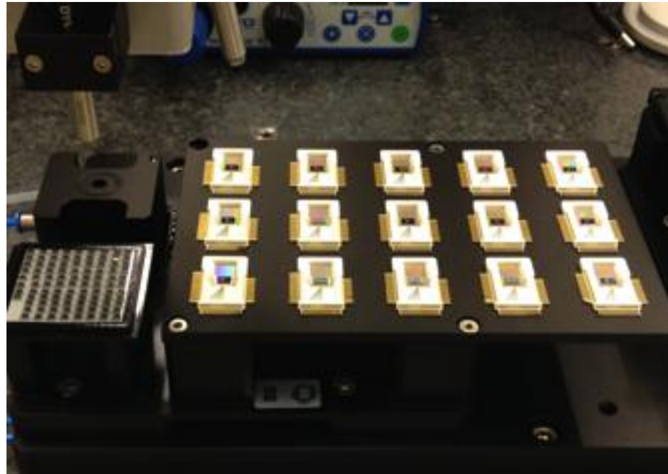
Automatic pigtailing/flip chip bench PI-miCos – Photo in our lab

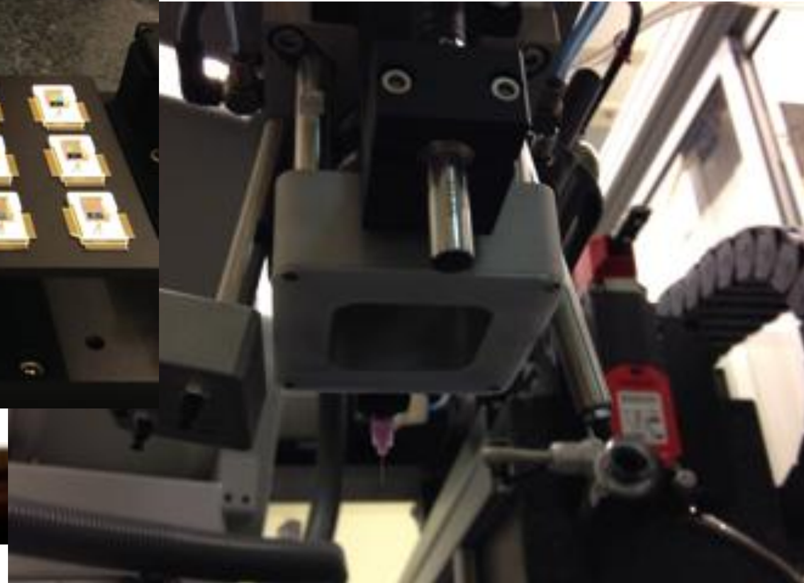
- **Bench designed for fibers and lenses pigtailing**
- **Robot used for component pick-up, vision, glue dispensing and UV curing**
- **Two submicron precision SpaceFAB positioners are used**
- **Vision assisted passive pre-alignment**
- **Active alignment performed using power monitoring**
- **Bench is designed to be flexible → allows different kind of chips/packages/fibers to be used**

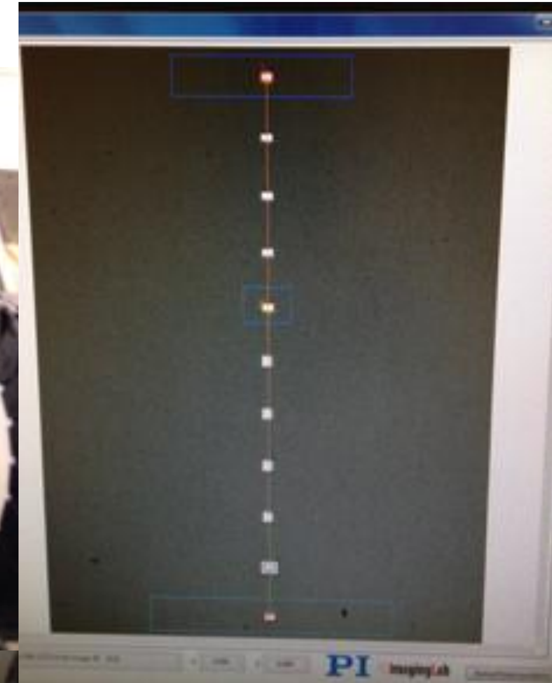
ISTITUTO DI TECNOLOGIE DELLA COMUNICAZIONE, DELL'INFORMAZIONE E DELLA PERCEZIONE
Scuola Superiore Sant'Anna

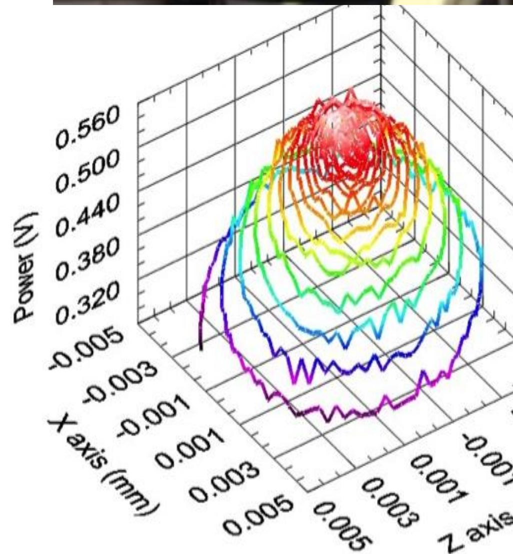
Inphotec Advanced Packaging Examples

INPHOTEC
Integrated Photonic Technologies Center

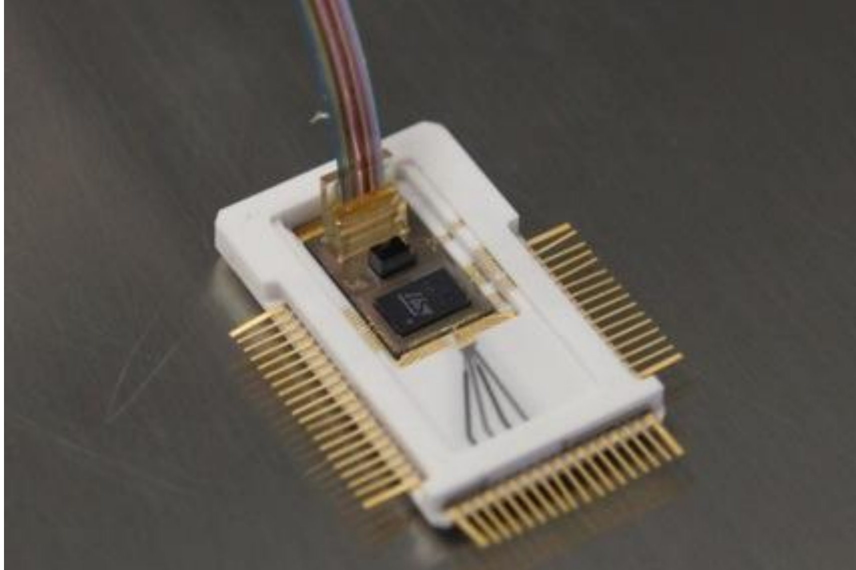


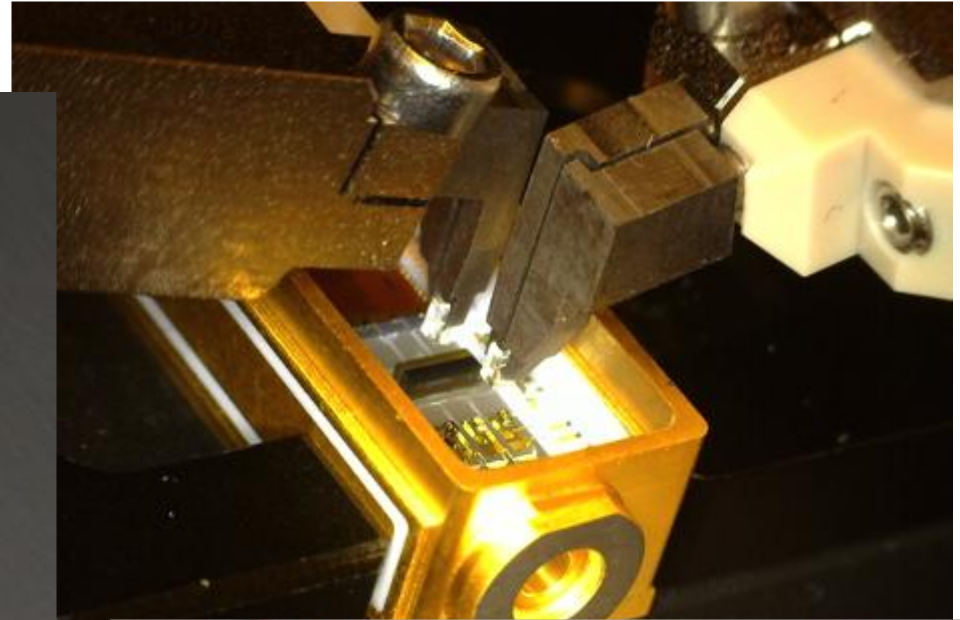


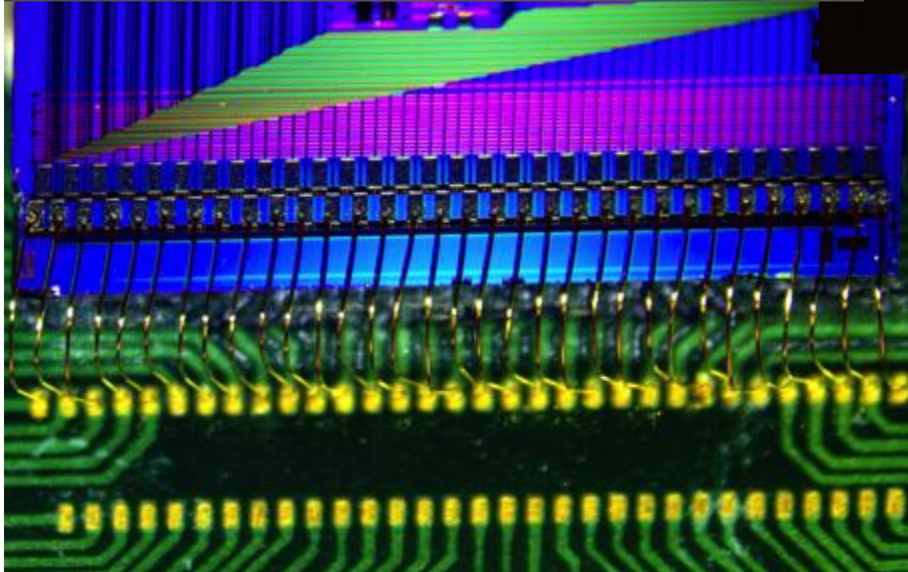


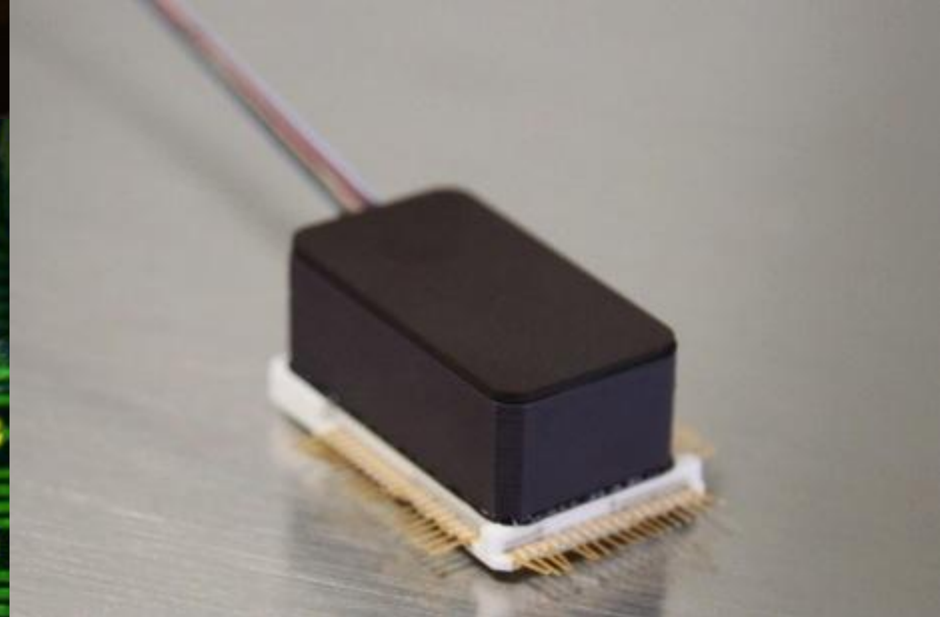


Inphotec Advanced Packaging Examples









ACTIVE PROJECTS AND CONTRACTS

Short History:

- Packaging Platform started activity January 2014
- Inphotec Facilities completed December 2014
- Inphotec Center Full Activities Started January 2015

European Projects **Cooperations**

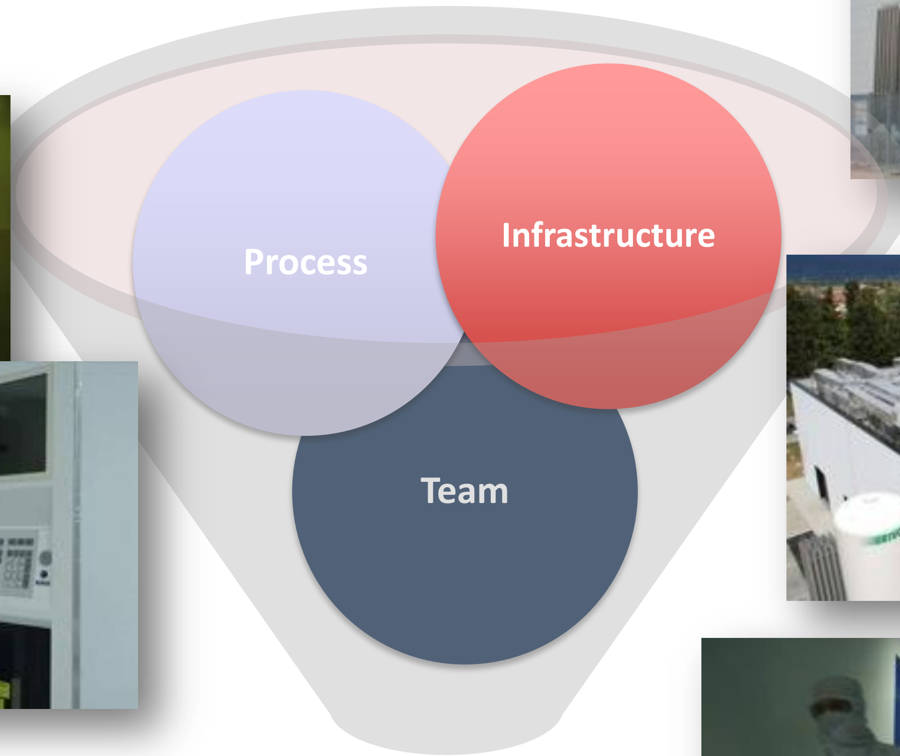
Customers

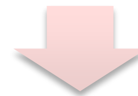
IRIS (2014-2016) TUB BERLIN
ERICSSON
ROAM (2014-2016) IZM FRAUNHOFER ST
MICROELECTRONICS
TERABOARD (2016-2018) IHP MICROELECTRONICS HUAWEI (CHINA)
MULTIPHOTON (GERMANY) IHP
MICROELECTRONICS
MC GILL UNIVERSITY (CANADA) CPqD (BRASIL)
CMC (CANADA)
GRAPHENE FLAGSHIP

ISTITUTO DI TECNOLOGIE DELLA COMUNICAZIONE, DELL'INFORMAZIONE E DELLA PERCEZIONE
Scuola Superiore Sant'Anna

Conclusion

INPHOTEC
Integrated Photonic Technologies Center





INPHOTEC
Integrated Photonic Technologies Center

ISTITUTO DI TECNOLOGIE DELLA COMUNICAZIONE, DELL'INFORMAZIONE E DELLA PERCEZIONE
Scuola Superiore Sant'Anna

INPHOTEC
Integrated Photonic Technologies Center

thank you!

email:
giovanbattista.preve@sssup.it
gbpreve@cnit.it