



EPIC Online Technology Meeting, 28 June 2021

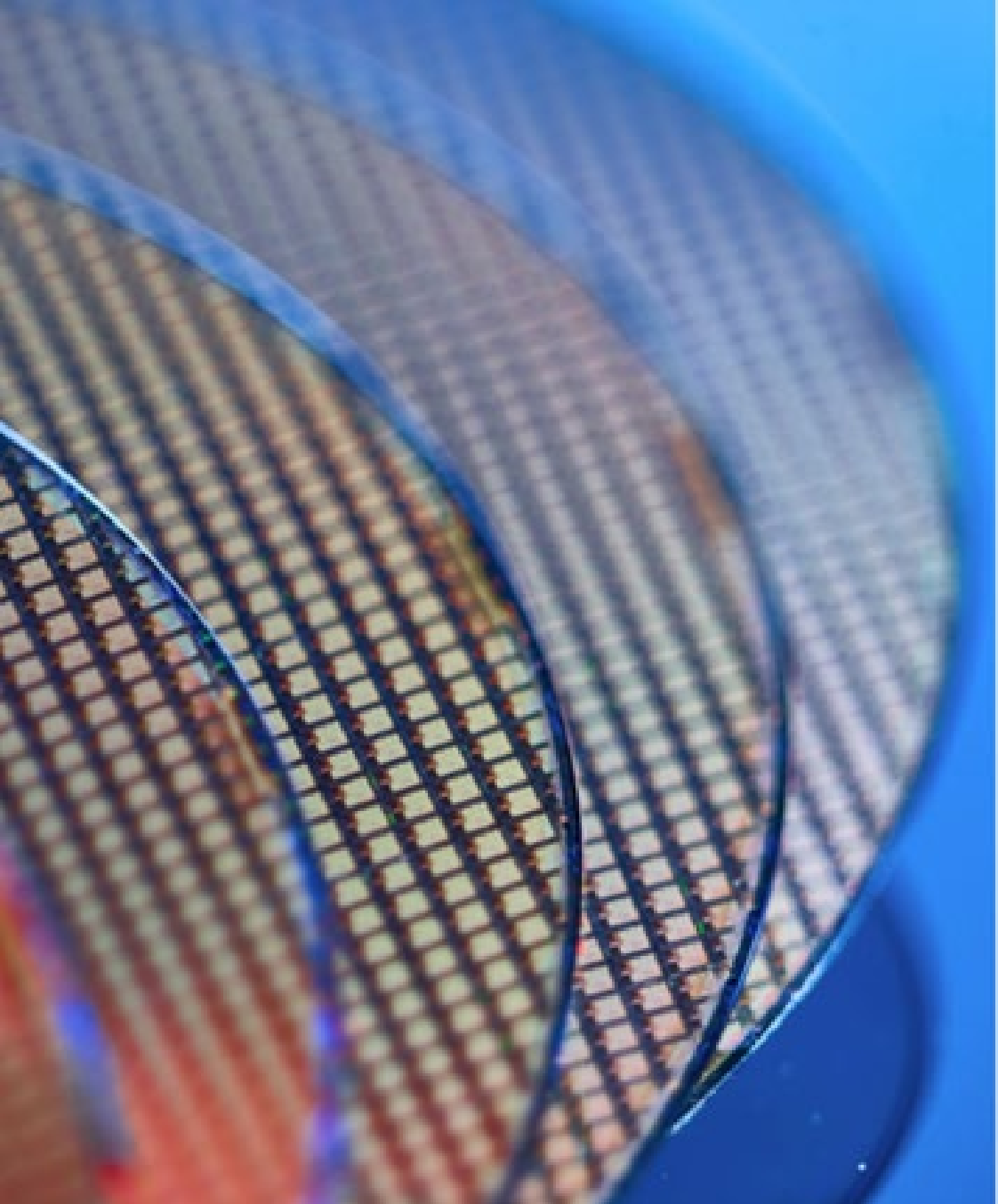
Novel Photonic Solutions for Microscopy

PHOTONICS IN SEMICONDUCTOR PROCESS CONTROL

Tristan COMBIER

Optical System Architect

- 1 UnitySC Introduction
- 2 Technologies portfolio
- 3 Confocal Chromatic
- 4 Doppler Darkfield



FOGALE nanotech

Altatech

HSEB
Nothing stays unseen

2016

unity^{SC}

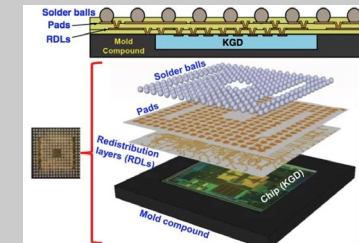
HQ: Grenoble, France

- **Mission:**

Solutions in **Metrology & Inspection** for **Semiconductor Industry**

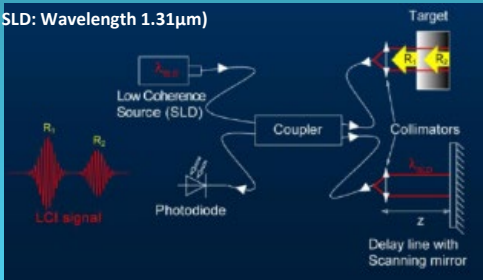
- **Main Applications:**

- Advanced Packaging & Wafer Level Packaging
- CMP (chemical mechanical polishing) process control
- Power device manufacturing
- MEMS, LED's, & substrate manufacturing

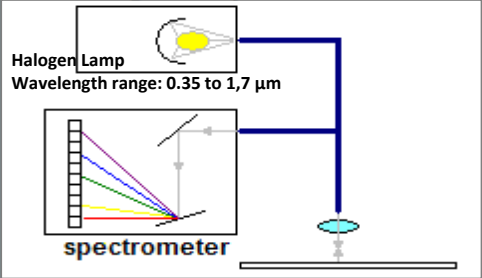


Advanced Metrology Solutions

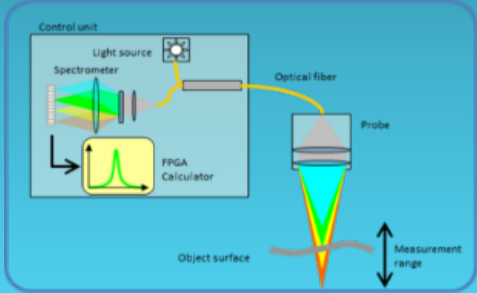
IR Interferometry:
Time Domain OCT



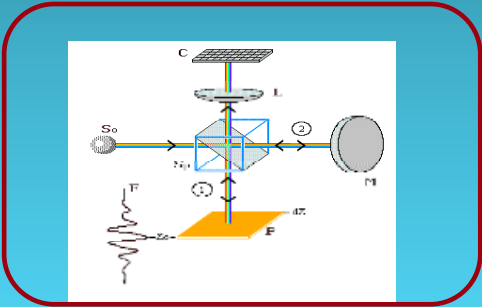
Spectral interferometry
Reflectometry



Confocal Chromatic



White Light
Full Field Interferometry

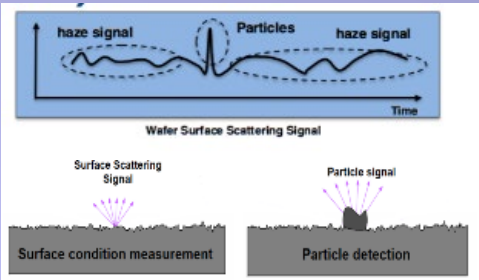


High Throughput Defect Detection

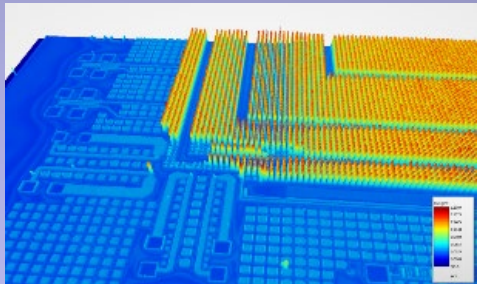
Phase Shift Deflectometry



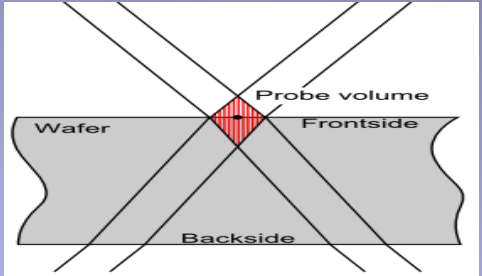
Darkfield Inspection



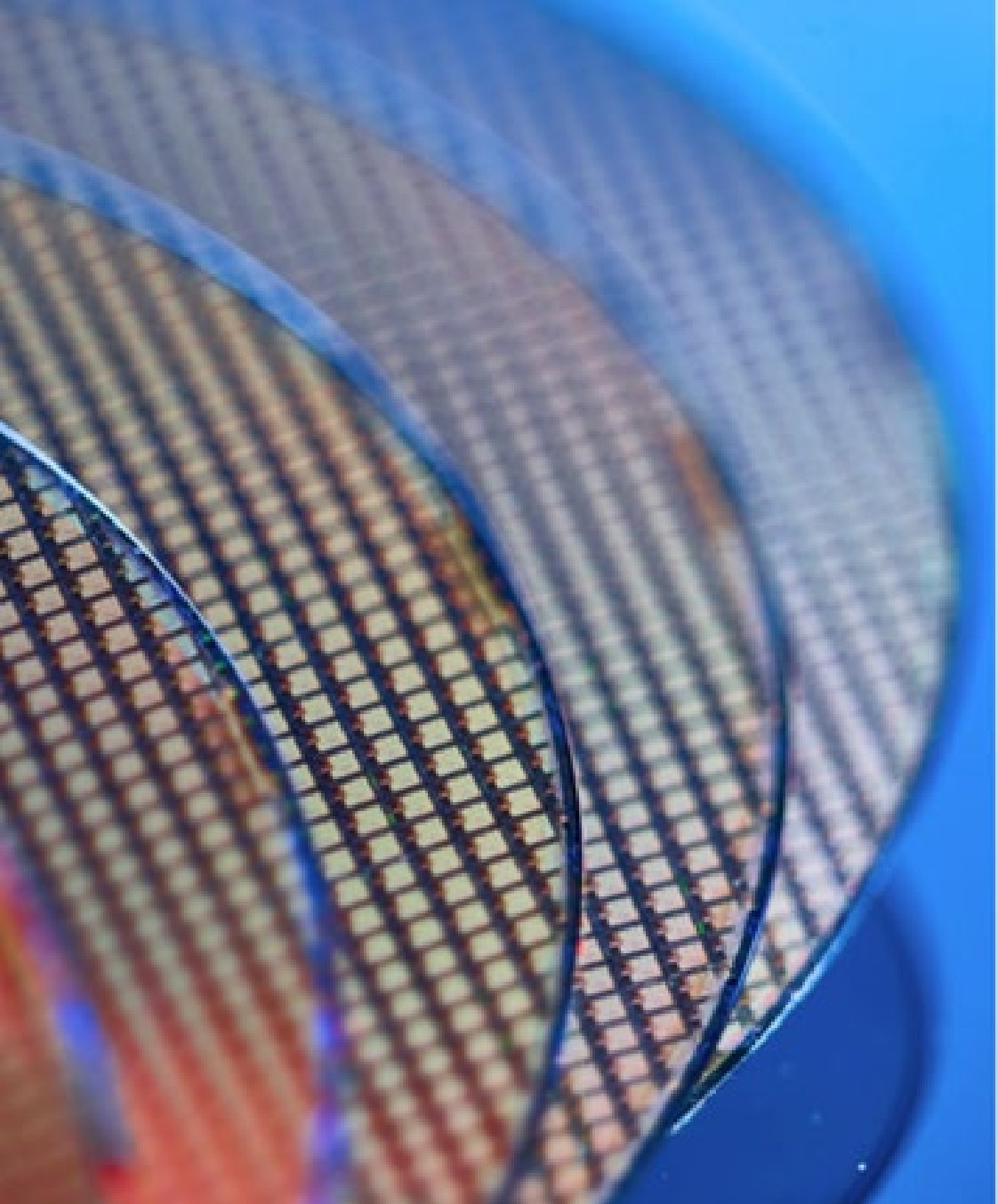
2D / 3D Linescan Inspection



Scanning Doppler Darkfield
(SDD™)

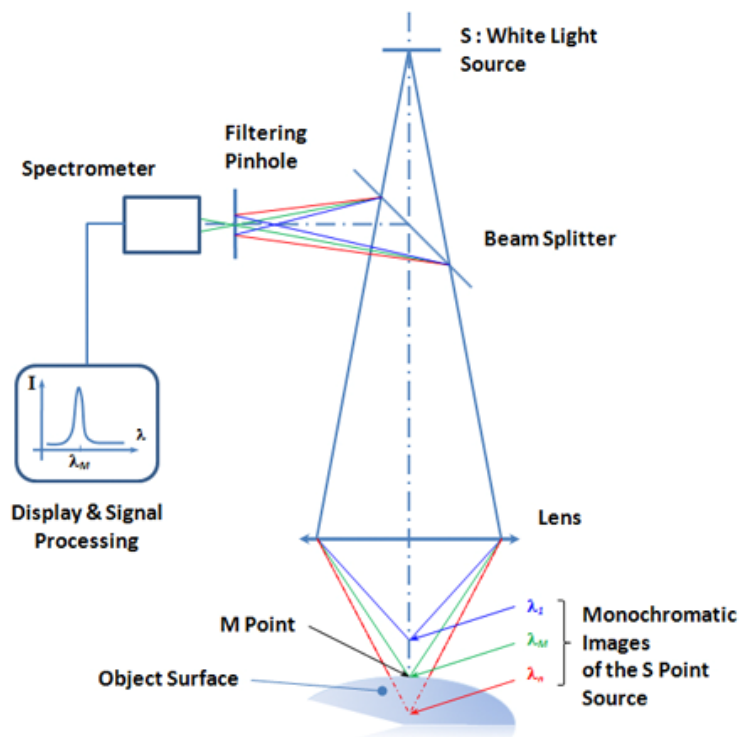


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CONFOCAL CHROMATIC MICROSCOPE

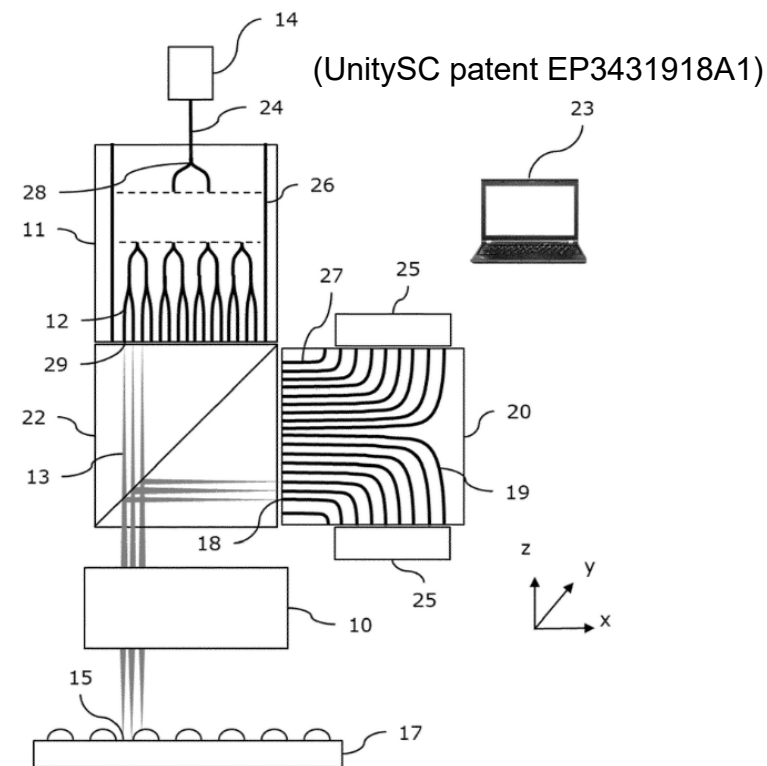
PRINCIPLE:



USING WAVEGUIDES



CONFOCAL CHROMATIC LINESCAN MICROSCOPE:



— wavelength \rightarrow pixel height

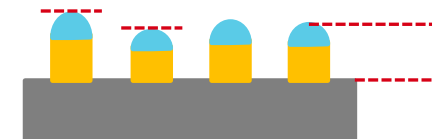
key advantages:

- large channel count \rightarrow high-speed surface topography
- high channel density \rightarrow μm lateral resolution

CONFOCAL CHROMATIC LINESCAN MICROSCOPE

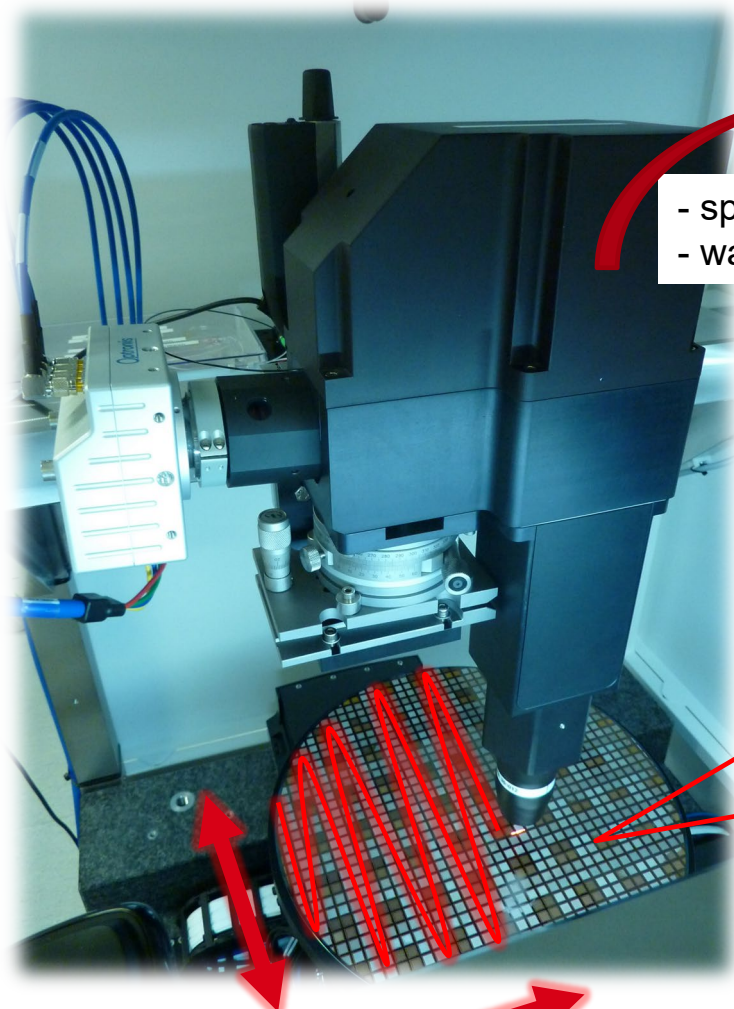
EXAMPLE APPLICATION:

MICRO-BUMPS PROCESS CONTROL

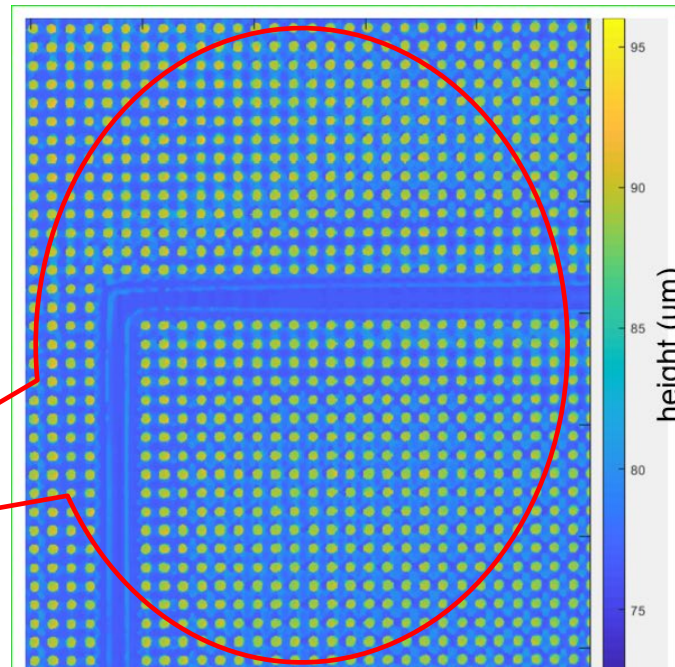


- spectral processing
- wavelength \rightarrow pixel height

- segmentation
- bump height measurement

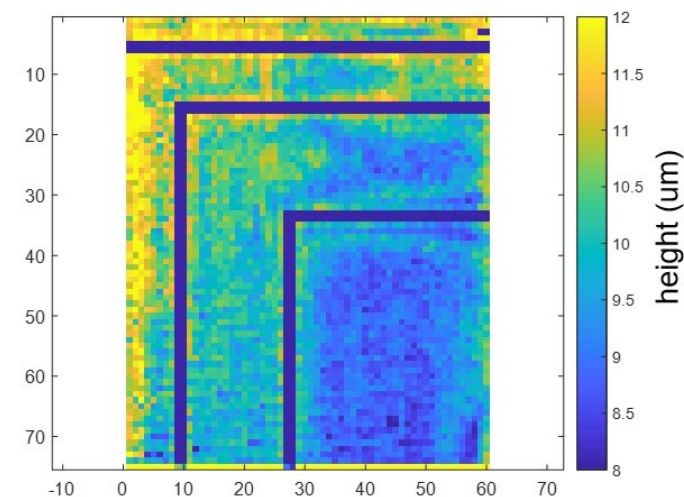


Raster scan



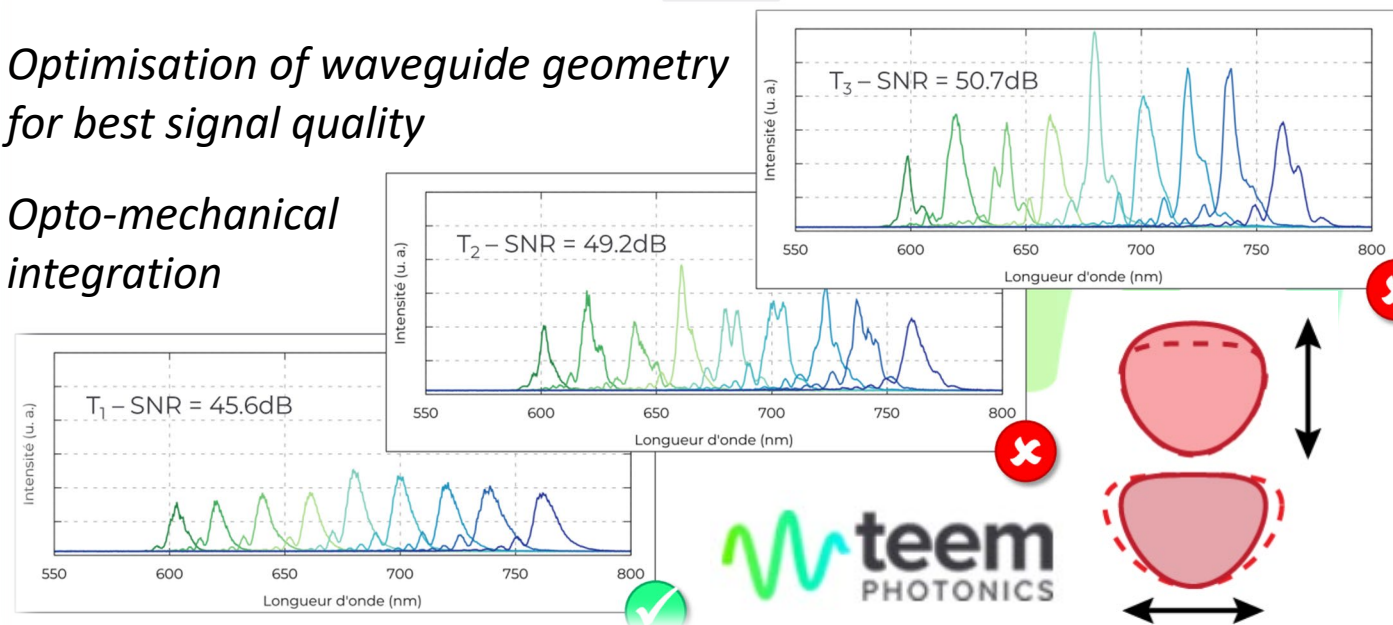
15um diameter bumps

bump height map:



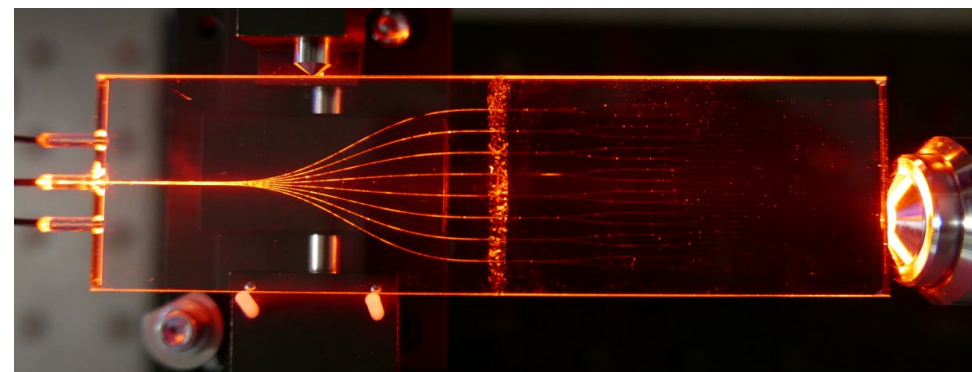
- 512 channels
- broadband visible range
- low loss, high homogeneity
- high power handling

- ✓ *Optimisation of waveguide geometry for best signal quality*
- ✓ *Opto-mechanical integration*

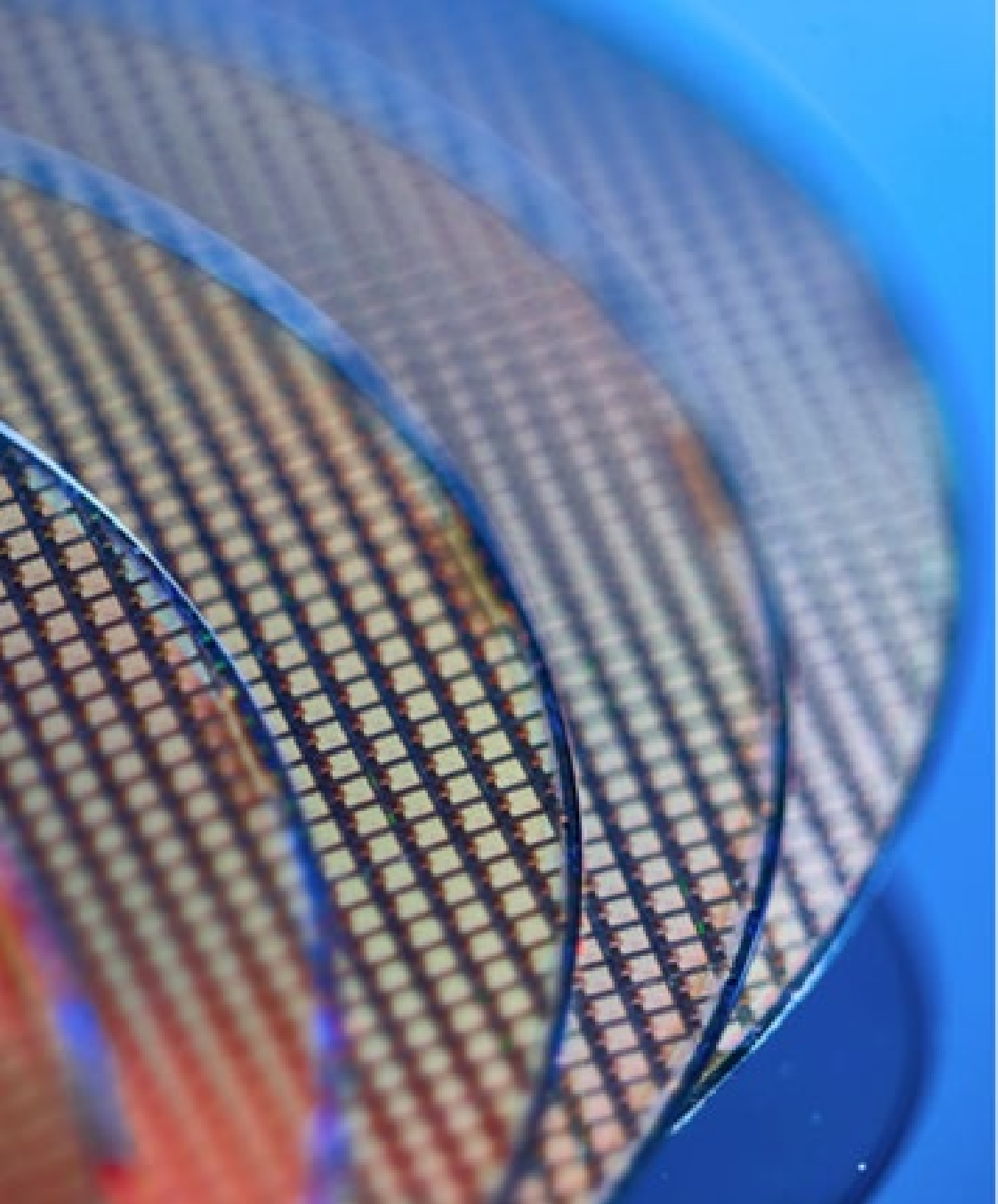


Future challenges

- **scalability**
 - spectrometer on chip
 - sources on chip
 - stack chips
- **versatility**
 - extend spectral bandwidth



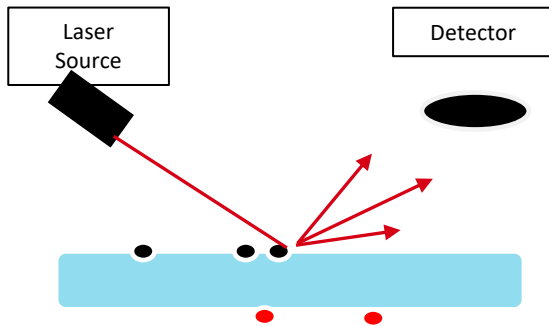
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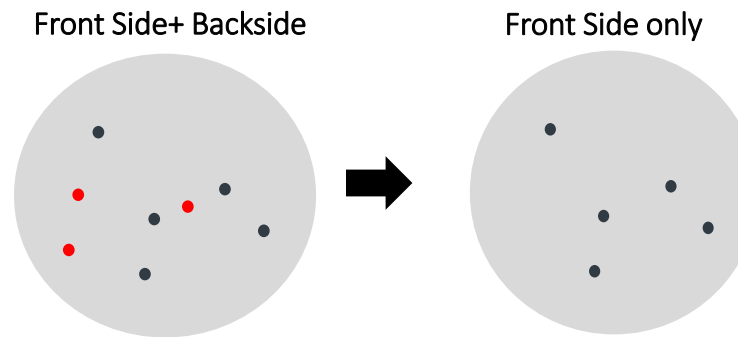
SCANNING DOPPLER DARKFIELD

PATENTED SDD™ TECHNOLOGY FOR GLASS CARRIER

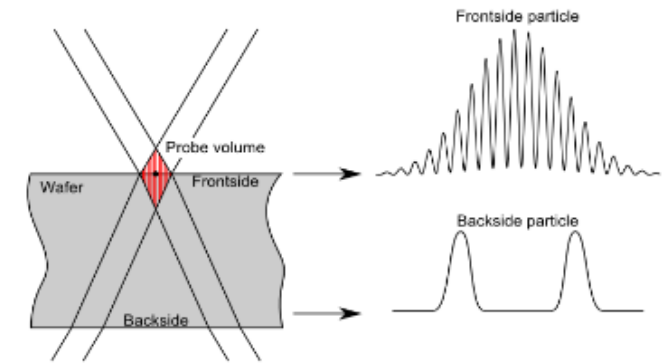
DF inspection



Differentiate FS/BS defects

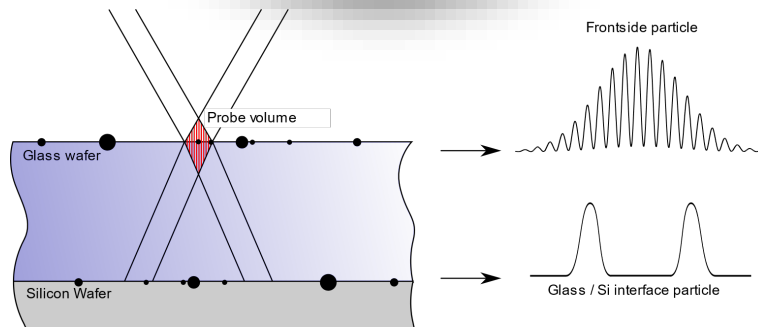
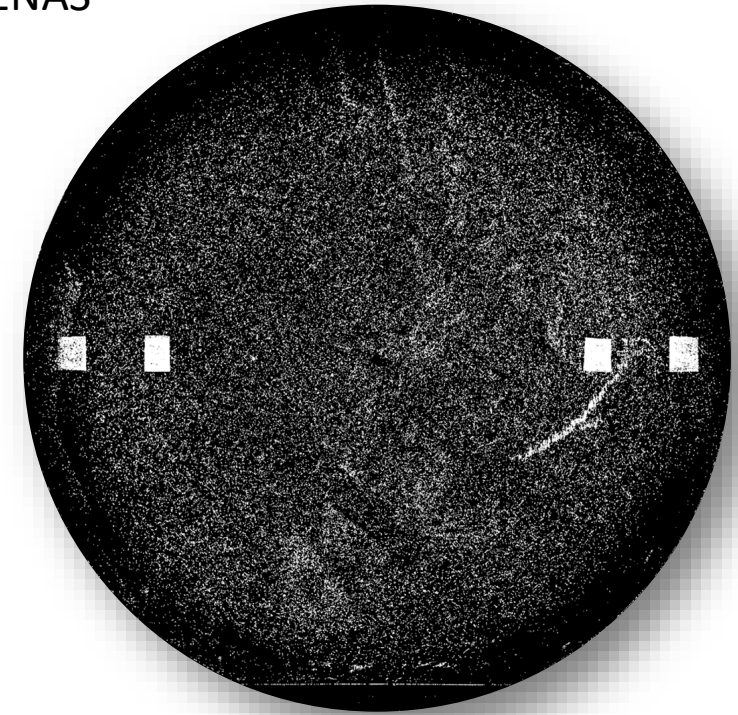
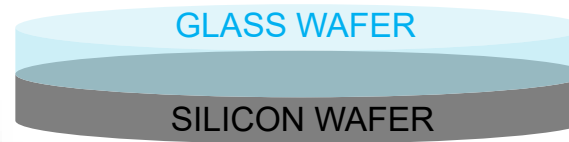
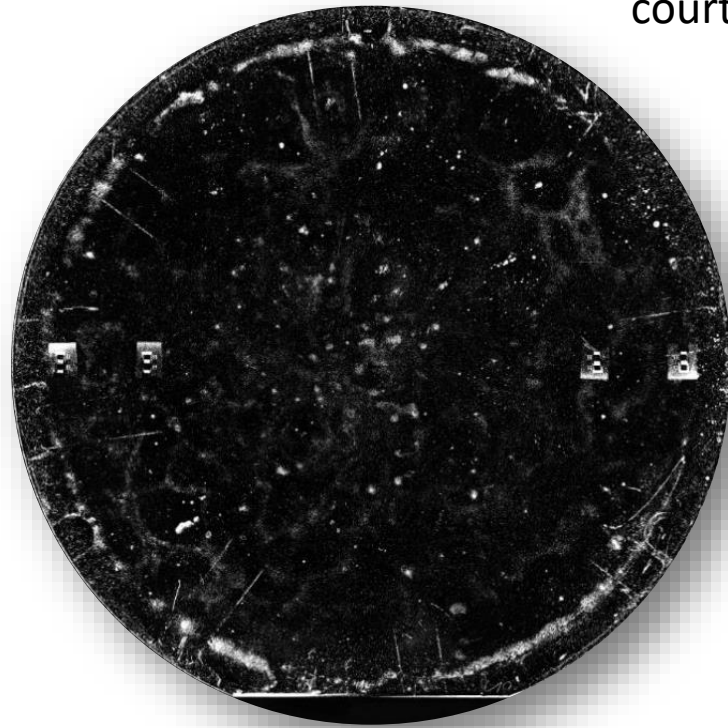


SDD™ technology

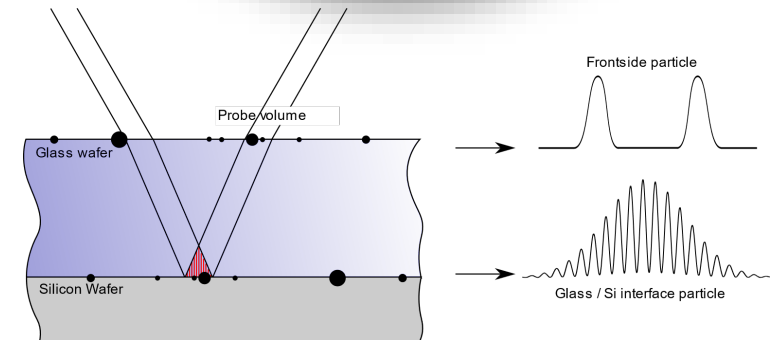


GLASS BONDED WAFER EXAMPLE DATA:

courtesy of the Fraunhofer institute ENAS



TOP OF GLASS



BOTTOM OF GLASS

Unity patent US2017/0219496

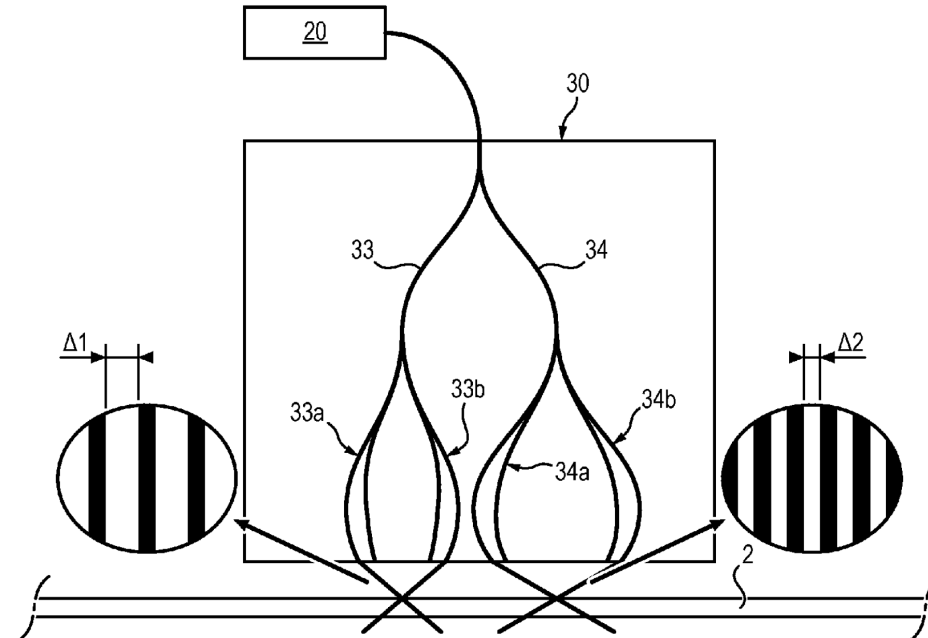
BEAM SPLITTING WITH WAVEGUIDES

Advantages:

- ✓ equal optical path length
- ✓ polarisation maintaining
- ✓ alignment-free
- ✓ scalability

Challenges:

- ❑ power handling (blue, UV)
- ❑ insertion loss
- ❑ interface with optics, beam shaping
- ❑ stray light suppression



GENERAL NEEDS FOR PHOTONICS IN MICROSCOPY

In our portfolio of technologies, we are always interested in:

- high power & short wavelength (blue – UV)
- high & low coherence light sources
- fibers endcapping
- controlled optical path length (interferometry)
- broadband waveguides
- spectrally flat splitters
- interface with free-space optics
- scalability

THANK YOU