

BIOSENSING USING INTEGRATED PHOTONICS

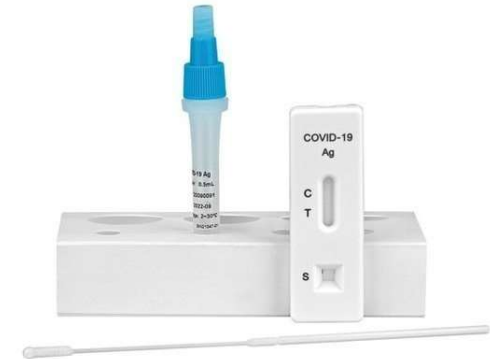
Peter Harmsma



TNO

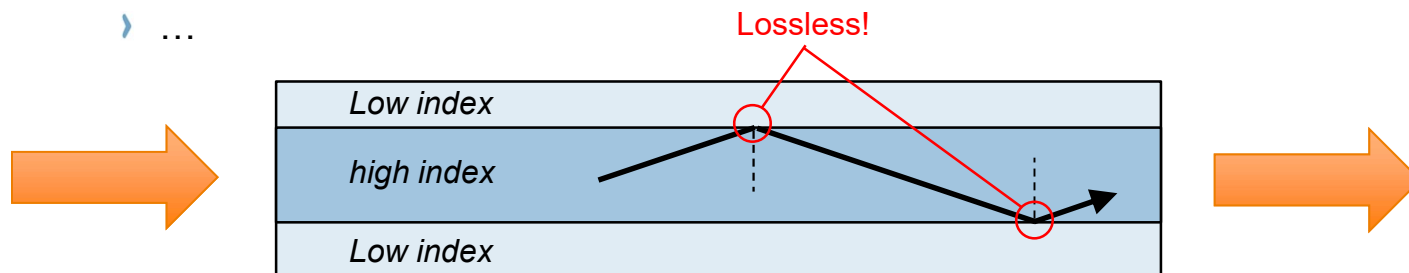
BIOSENSING

- › Diagnostics
 - › Identify biomarkers in body fluids representative for specific diseases
 - › Home / general practitioner / hospital
- › Drug development
 - › Development of biochemistry (assays) to identify biomarkers
- › Combination of both domains
 - › Many potential assays do not qualify in practice
 - › Success rate improves if development and test make use of the same technology – cost reduction



PHOTONICS

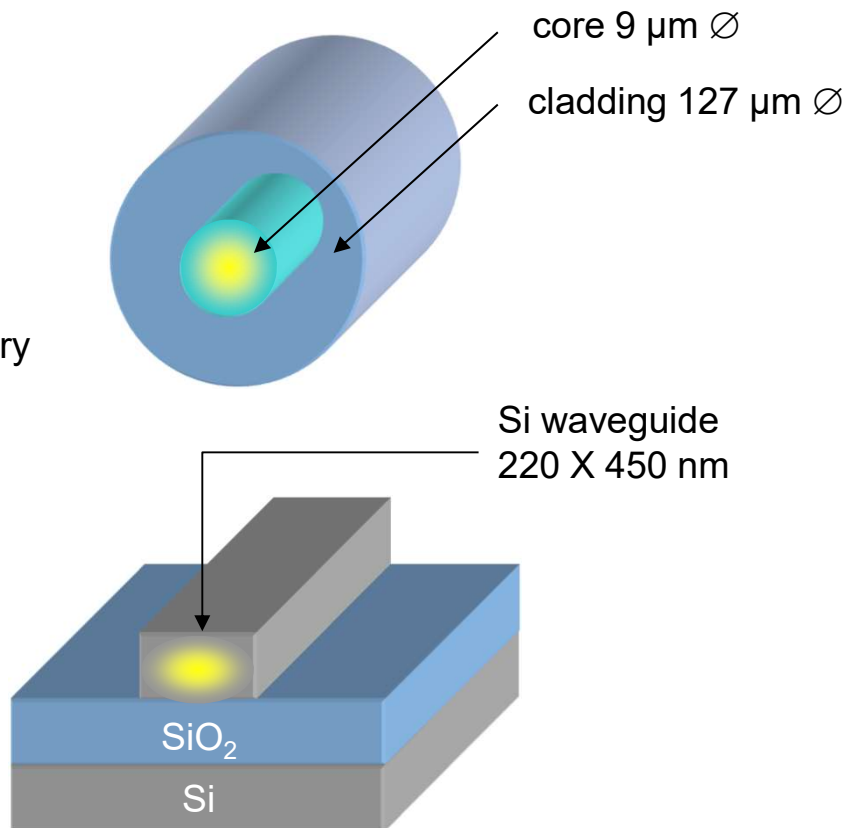
- › Manipulation of light on small dimensions
 - › Large devices are typically referred to as 'optics'
- › Example: optical fiber
 - › Communication
 - › Sensors
 - › ...



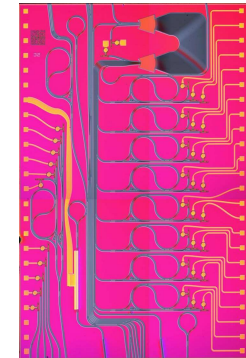
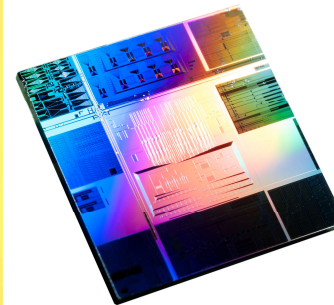
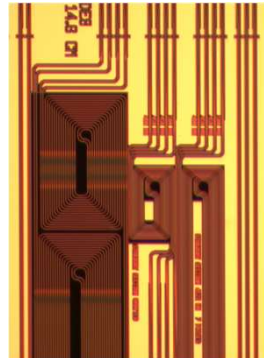
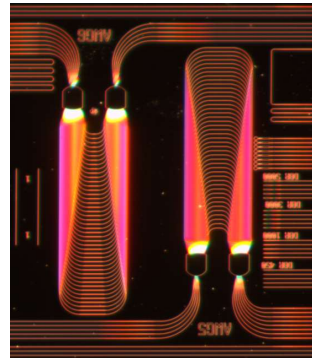
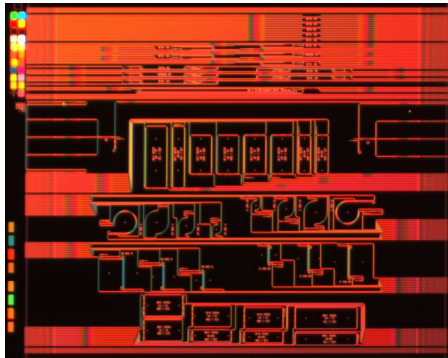
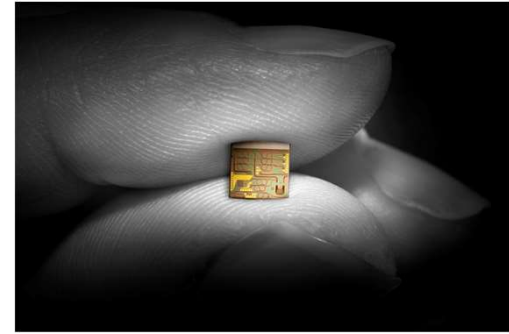
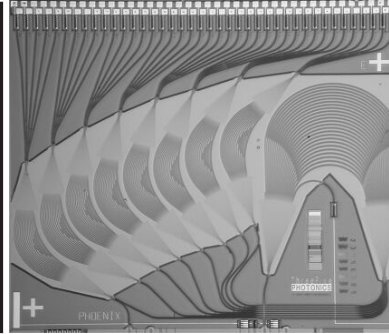
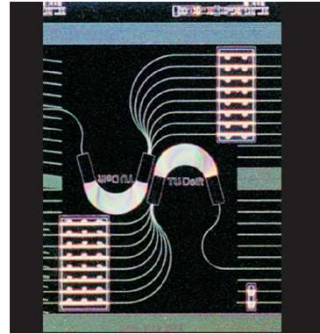
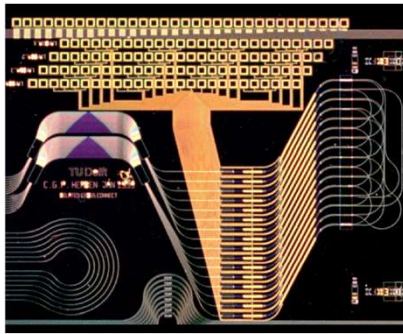
- › 17 km fiber has 50% transmission!

INTEGRATED PHOTONICS

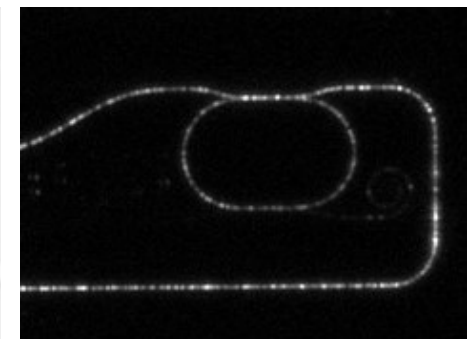
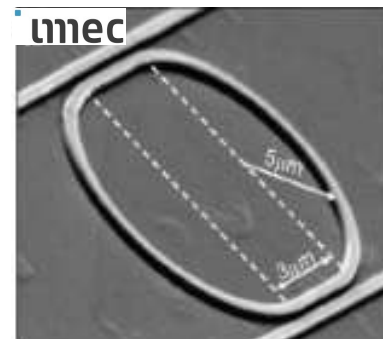
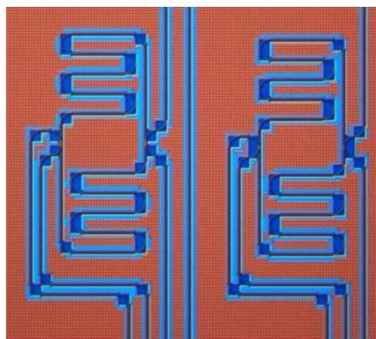
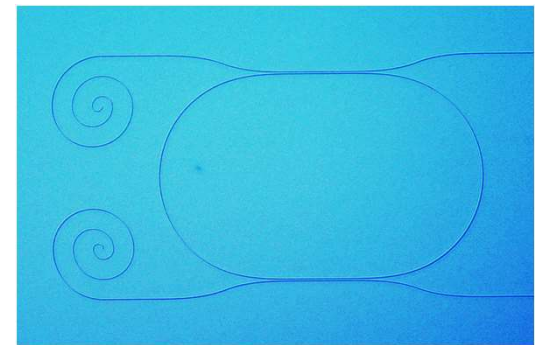
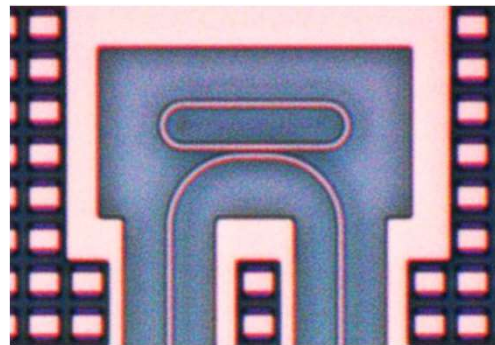
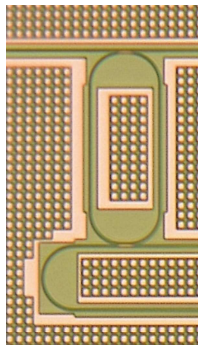
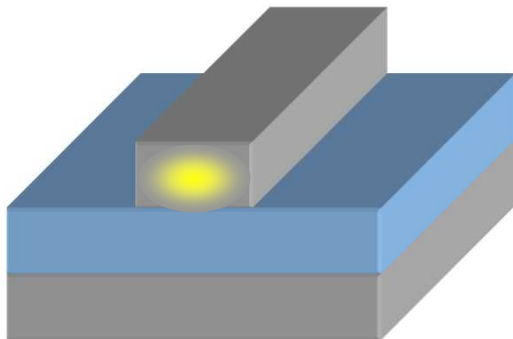
- › 'Fiber on chip'
 - › Rectangular Cross Sections
 - › Freedom to design in-plane geometry
 - › Huge variety of devices
- › Fabrication technology similar to electronics industry
- › Mature ecosystem
 - › Foundry services
 - › Various material platforms
 - › Design software
 - › Design houses
- › Combine electrical and optical functionality
 - › Generation & detection
 - › Switching
 - › Amplification



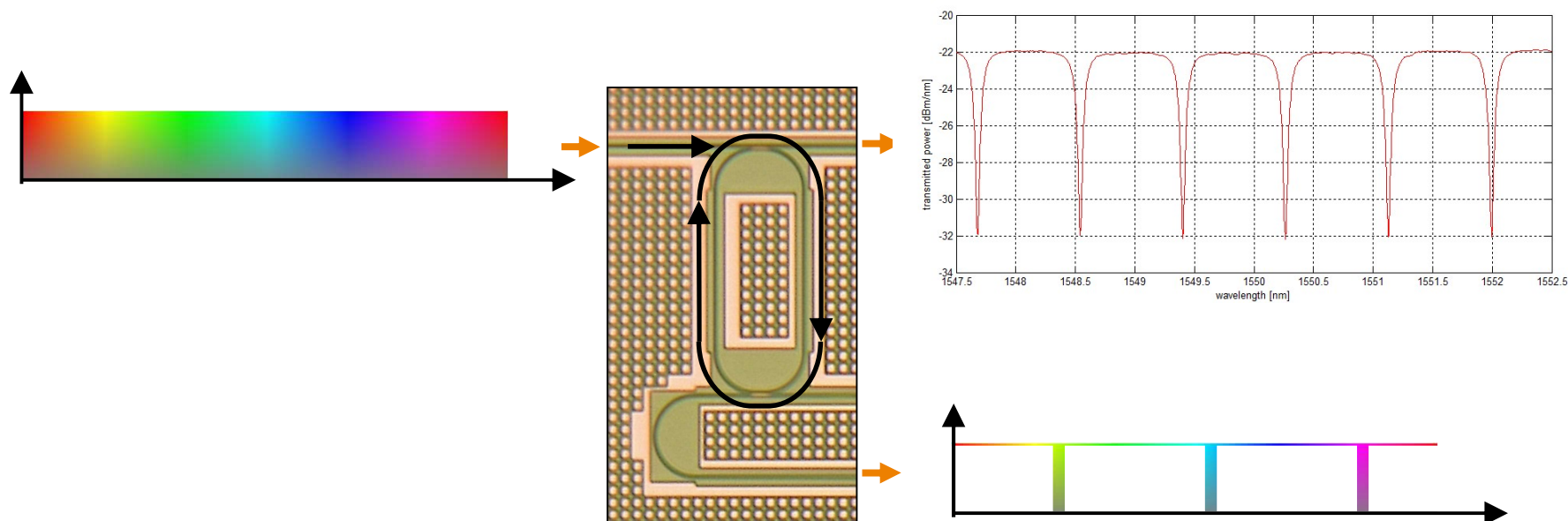
INTEGRATED PHOTONICS



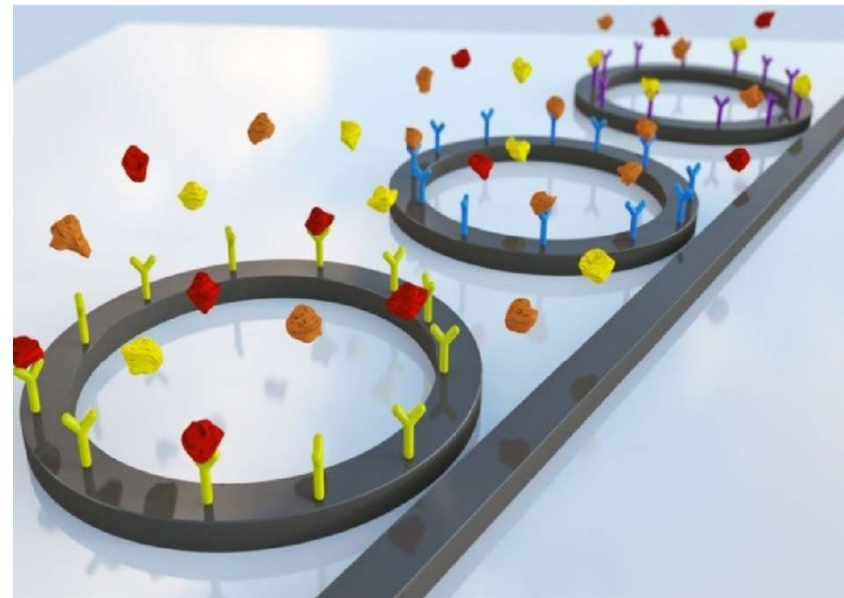
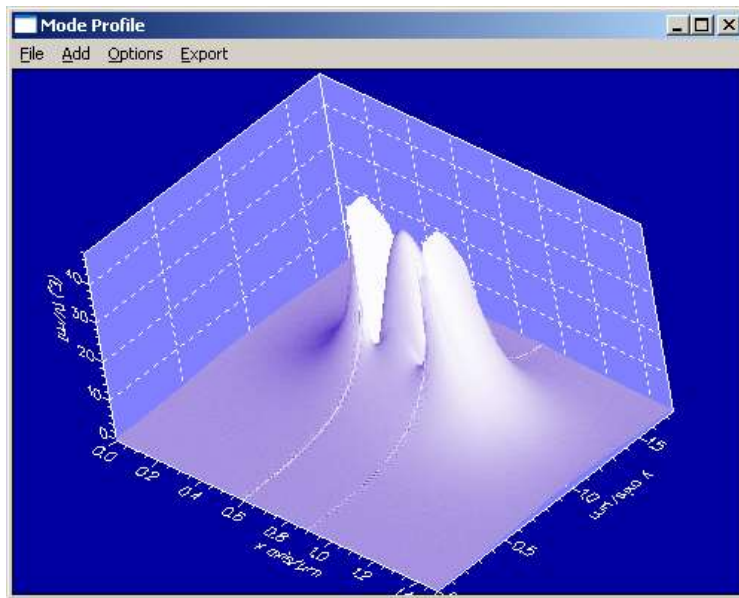
INTEGRATED PHOTONICS: RING RESONATOR



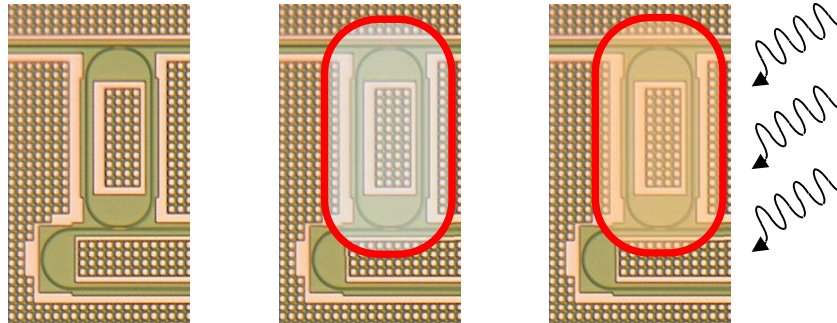
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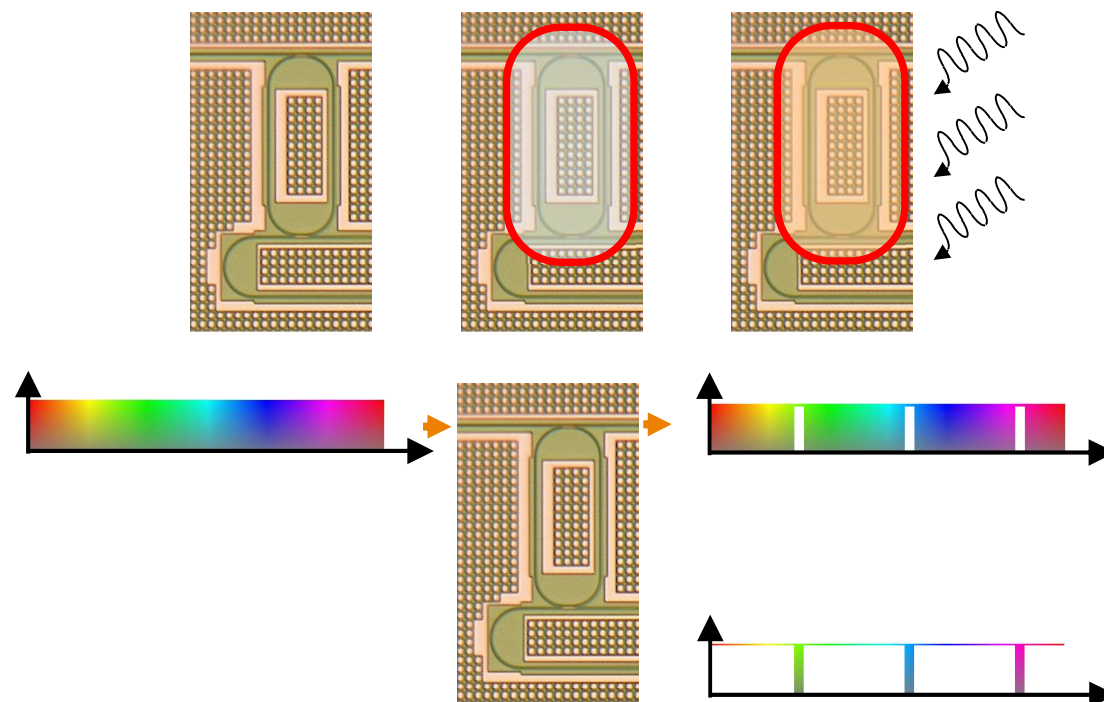
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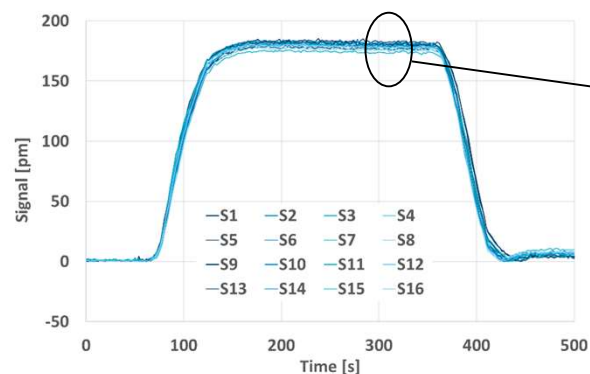
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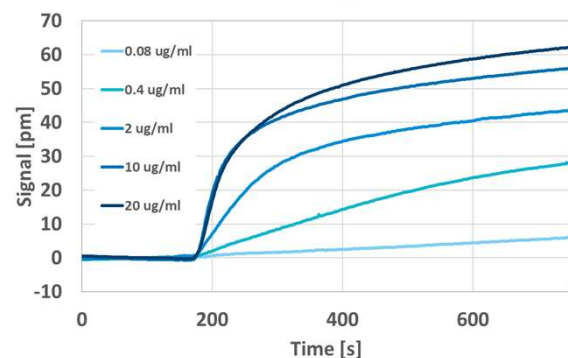
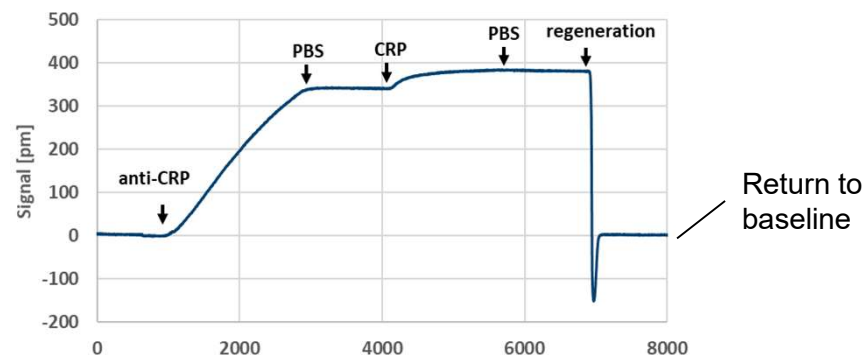
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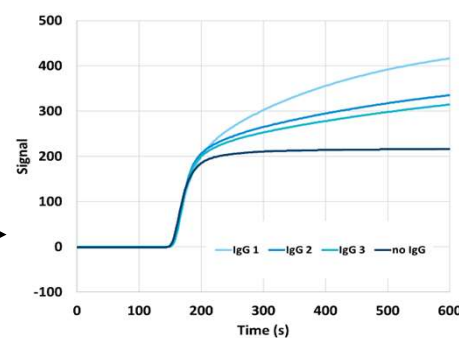
INTEGRATED PHOTONICS: RING RESONATOR



16 sensors
multiplexed in
single
experiment.
Excellent
sensor-to-
sensor-
reproducibility

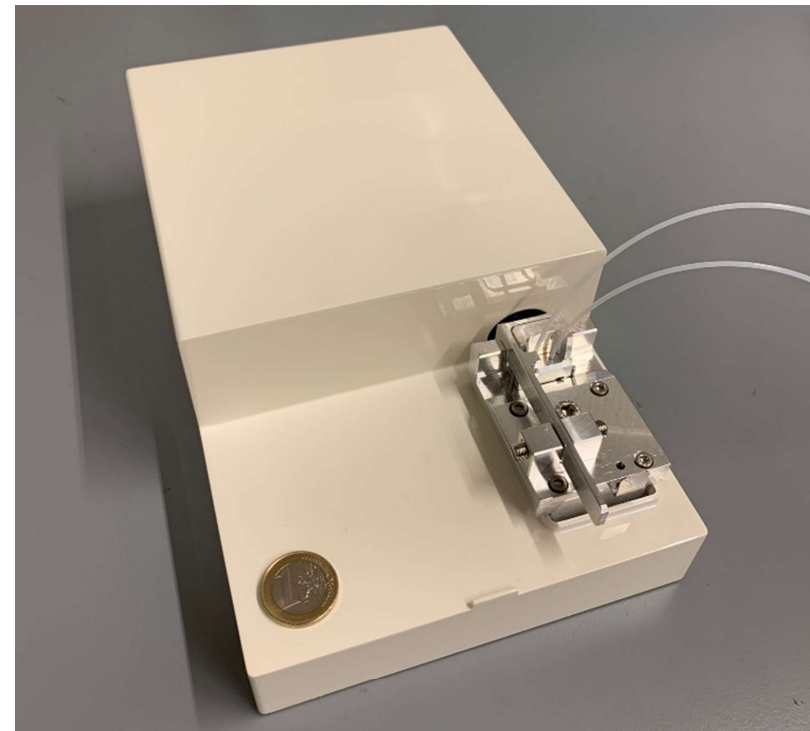
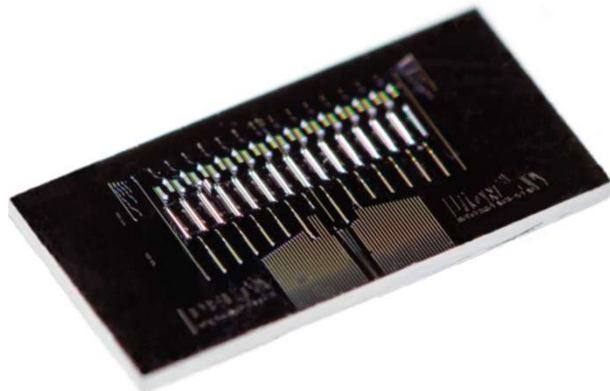


Sensorgrams: LOD
comparable to SPR



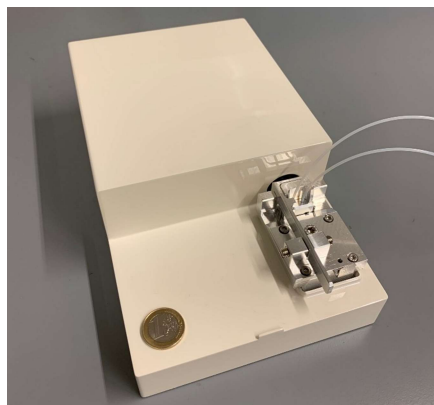
INSTRUMENTATION: DELTA DIAGNOSTICS

- › Current focus: lice science instrumentation
- › Future: match with Point Of Care applications



COMPARISON TO STATE OF THE ART

- › Comparable performance today
 - › Further LoD improvement in progress
 - › Parallelization
- › Reduced costs
 - › Instrument
 - › Sensor
- › Miniaturization towards Point-Of-Care
 - › Same platform for development & application



PHOTONIC INTEGRATED CIRCUITS: WHAT ELSE?

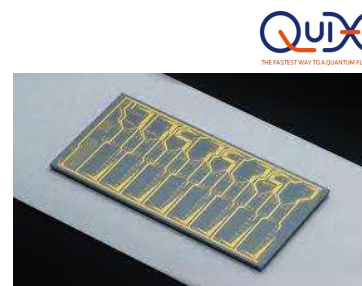
Datacom / telecom



Automotive



Quantum



Metrology



Sensors



your application here!

LOW-THRESHOLD ACCESS TO PHOTONICS

- › EU project ACTPHAST
 - › ACTPHAST 4.0: for companies
 - › ACTPHAST4R: for researchers
- › Provides technology support in the field of photonics
 - › Feasibility studies
 - › Prototyping
 - › Test and measurement
- › Heavily subsidized (up to 100%)
- › Pool of experts from 25 EU universities and research institutes



LOW-THRESHOLD ACCESS TO PHOTONICS

- › > 100 companies supported so far
- › <https://www.actphast.eu/en>
- › <https://company.actphast.eu/en>
- › <https://researcher.actphast.eu/en>

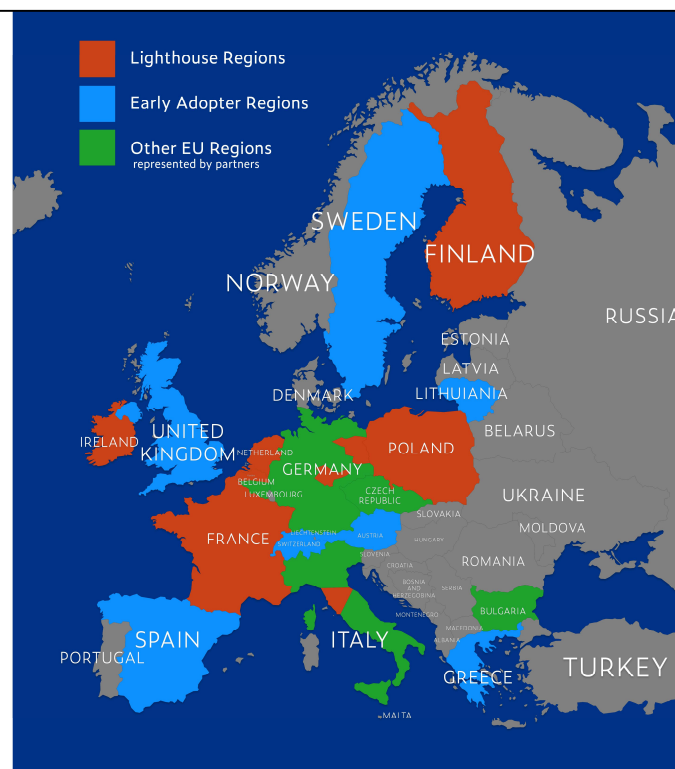


LOW-THRESHOLD ACCESS TO PHOTONICS



500+ EXPERTS
15 MEMBER STATES
54 PARTNERS

36 Technology Support partners
18 Local Photonics Hub partners
+ 6 Business Support partners



SUMMARIZING

- › Photonic chips are mature technology
- › Delta Diagnostics is commercializing photonic biosensing
- › Your business may benefit from photonics technology
- › EU-subsidized initiatives can help you

THANK YOU