HITACHI
Inspire the Next

EPIC Photonics, Lausanne

Biofunctionalization of Silicon Chips for PIC Sensors

13/03/2025

Frederic Brossard

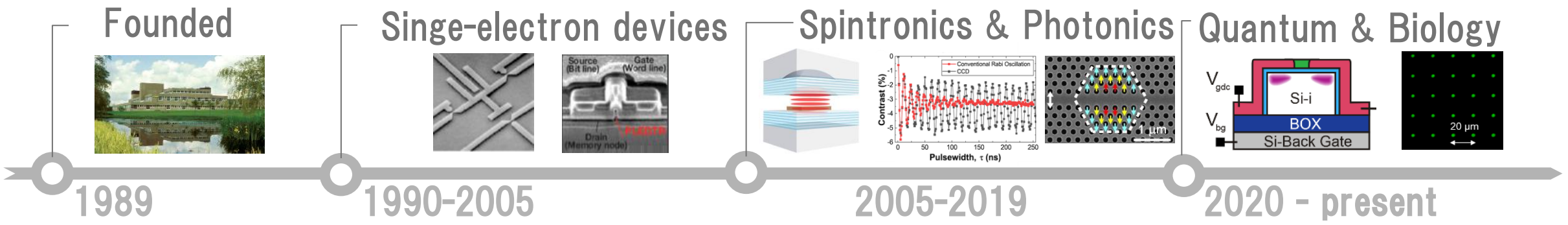
Hitachi Cambridge Laboratory

© Hitachi, Ltd. 2025. All rights reserved.

Hitachi Cambridge Laboratory history

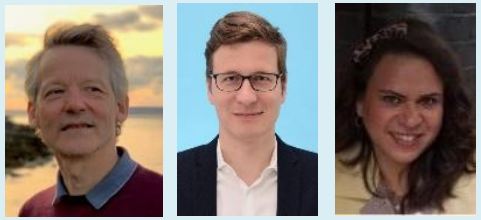
HITACHI
Inspire the Next

History:



Organization:

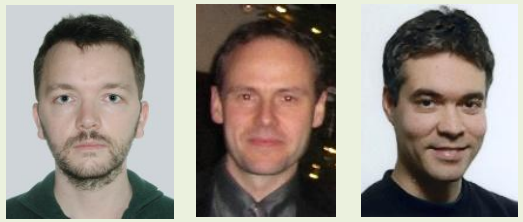
Management



Charles Smith | Normann Mertig | Jannette Roberts

Biology

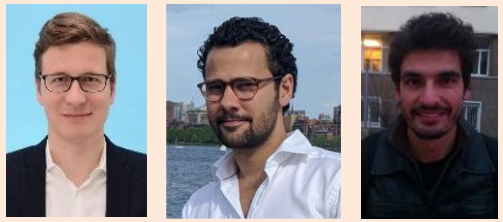
Carbon transformation



William Rostain | Fréderic Brossard | Pierre Roy

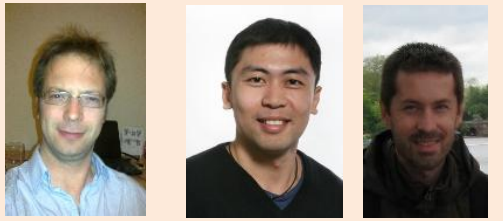
Quantum

Algorithms



Normann Mertig | David Arvidsson Shukur | Rubén Otxoa

Hardware



Andrew Ramsay | Tsung-Yeh Yang | Thierry Ferrus

© Hitachi, Ltd. 2025. All rights reserved.

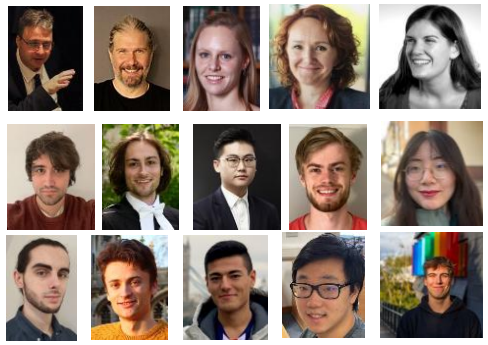
Cambridge Ecosystem

HITACHI
Inspire the Next

Access to world-leading innovation, talent, partners, and grants

Cambridge

Established 1989.
Currently 5 professors &
15+ students



Since 2020:
50+ journal publications
(5x Nature family)

United Kingdom, Europe, and the World

Access to world-leading qubit fabrication partner

European Commission

View of EU startup ecosystem

UNIVERSITY OF CAMBRIDGE enterprise

UKRI Innovate UK

CAMBRIDGE ZERO

seeqc

Access to world-leading global academic network

VIRGINIA TECH

Universidad de Navarra

One Hitachi

R&D group members

Communication with BU.

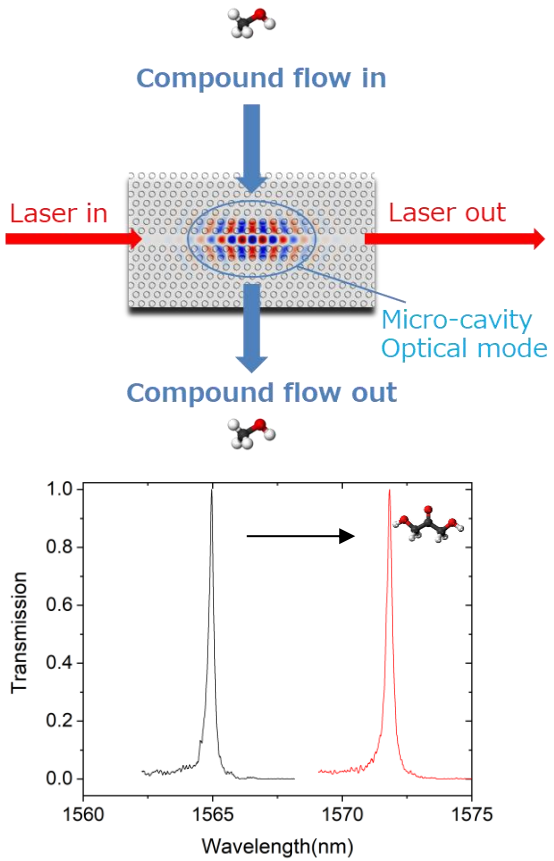
HITACHI Ventures

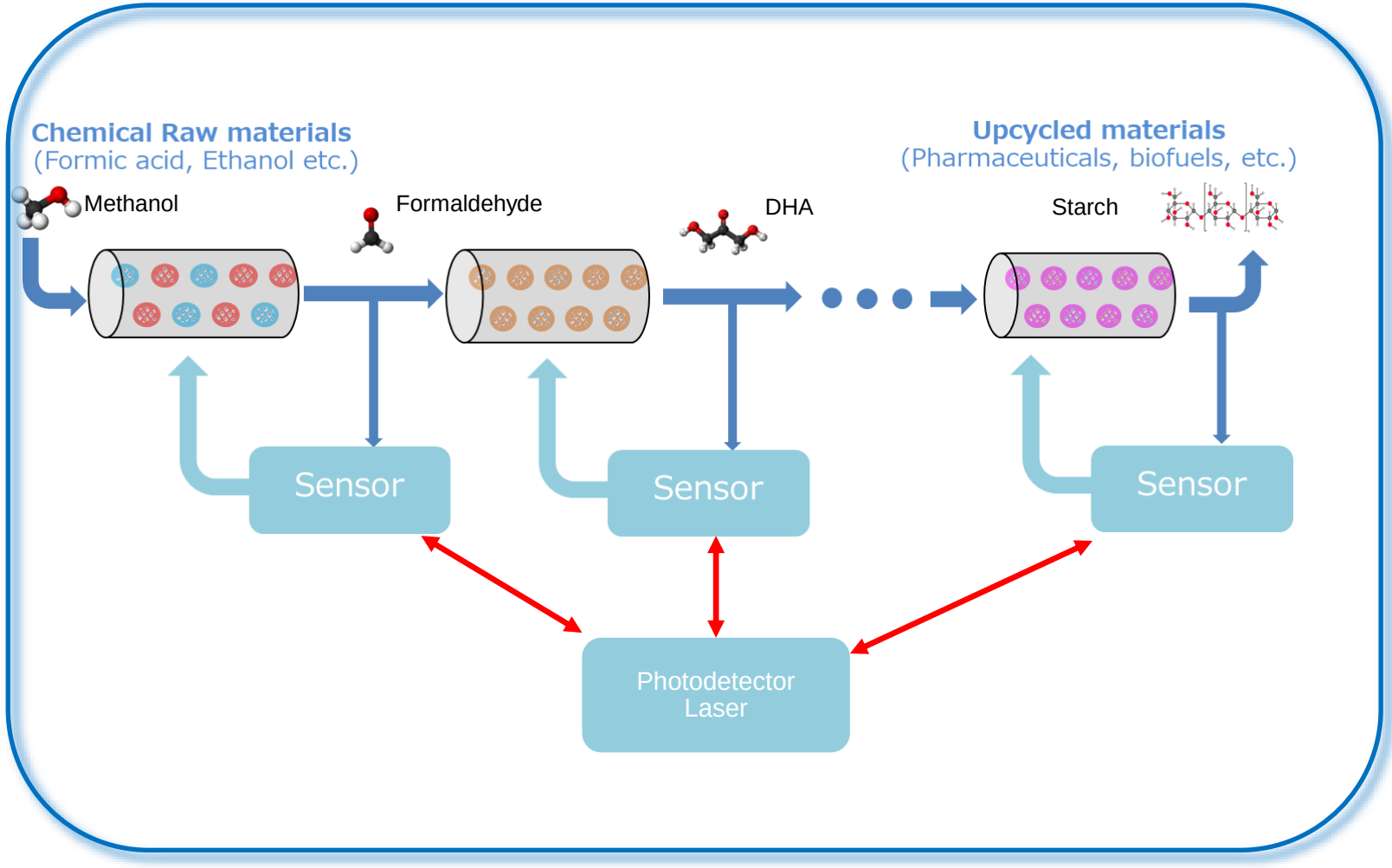
VLC PHOTONICS A Hitachi Group Company

Hitachi Energy

© Hitachi, Ltd. 2025. All rights reserved.

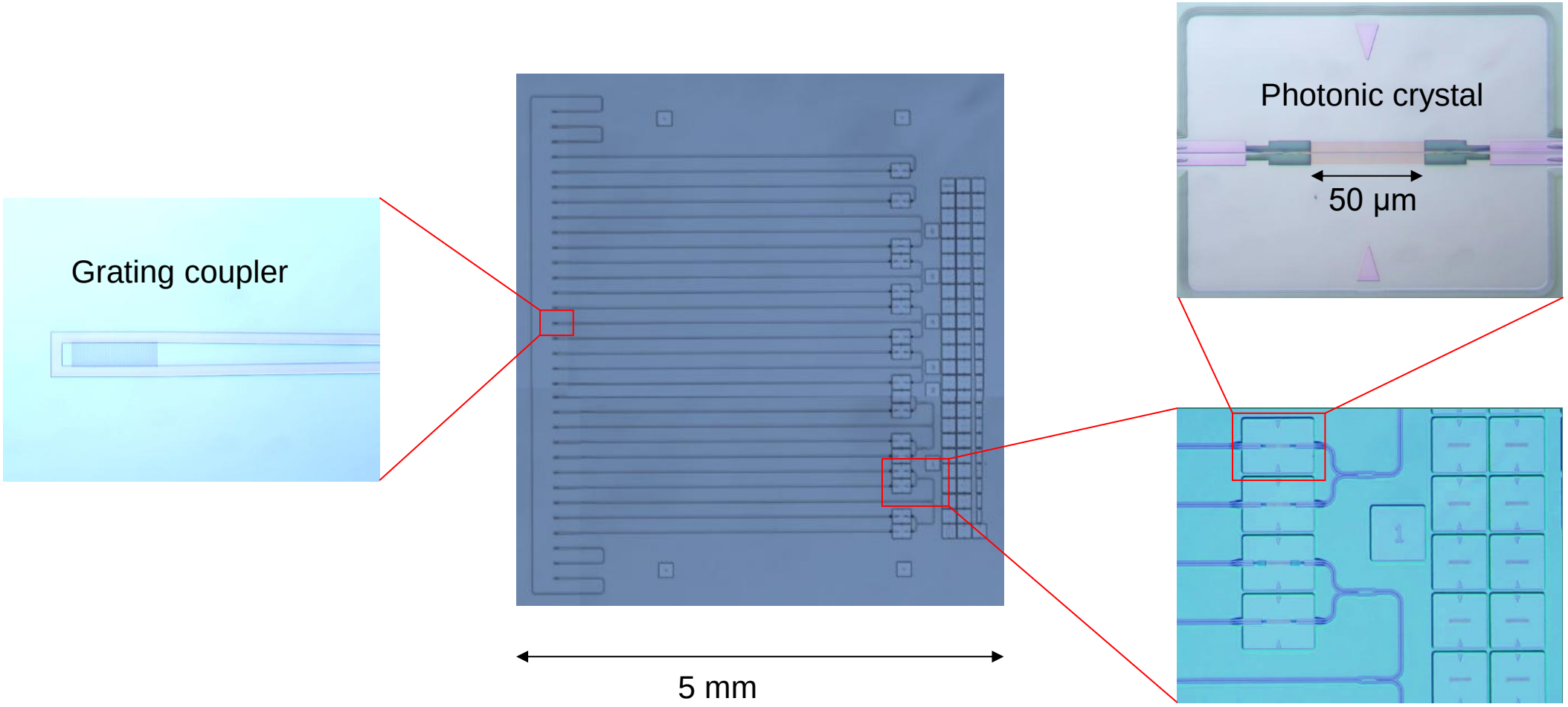
Photonic sensing principle and motivation





© Hitachi, Ltd. 2025. All rights reserved.

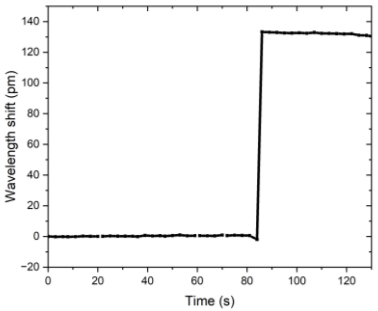
Photonic sensor design



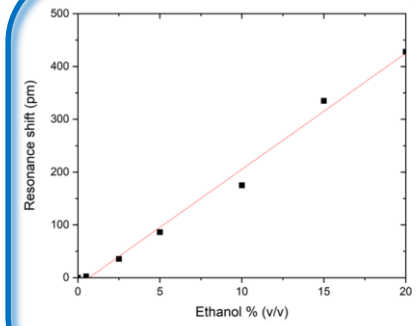
© Hitachi, Ltd. 2025. All rights reserved.

Photonic sensor demonstrator

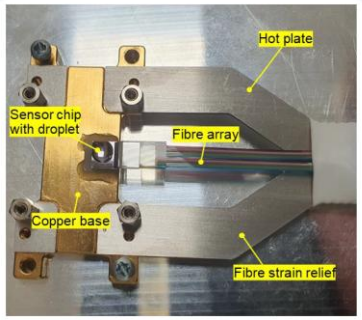
HITACHI
Inspire the Next



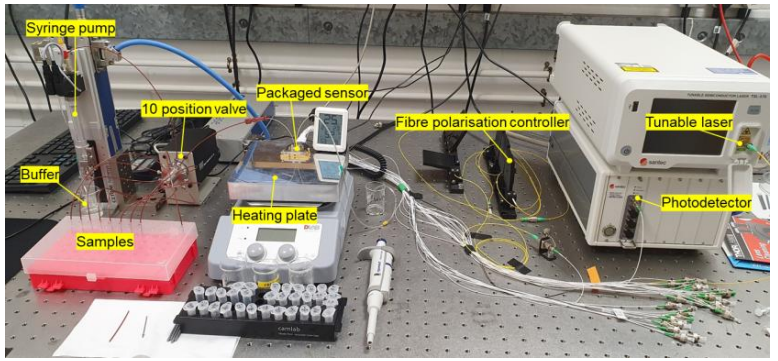
Mode tracking



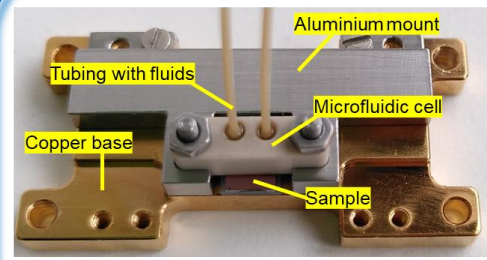
Sensing



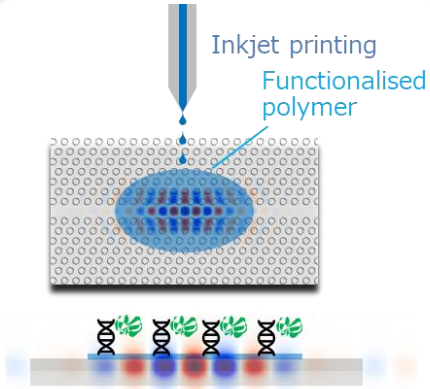
Packaging



Biosensing set-up



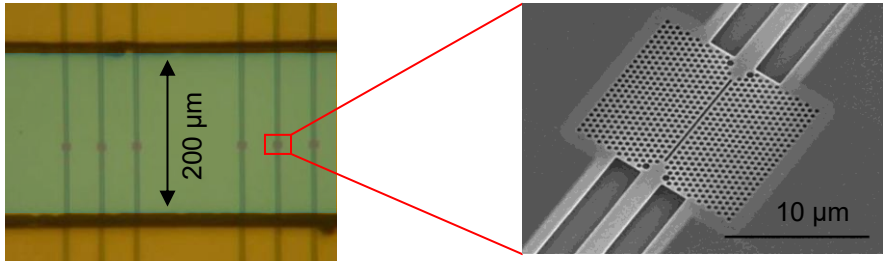
Microfluidics



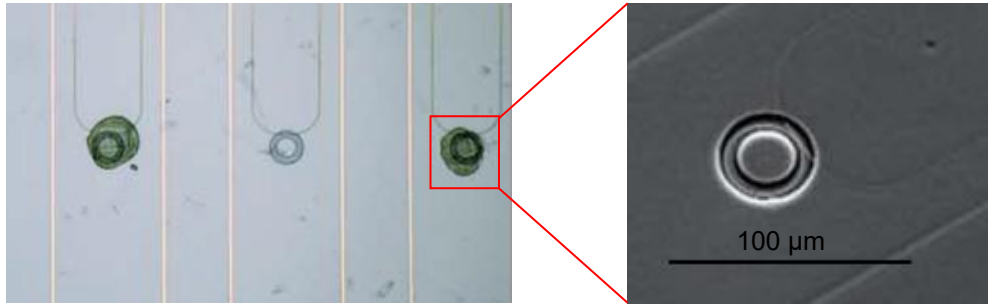
Functionalization

© Hitachi, Ltd. 2025. All rights reserved.

Functionalizing transducers



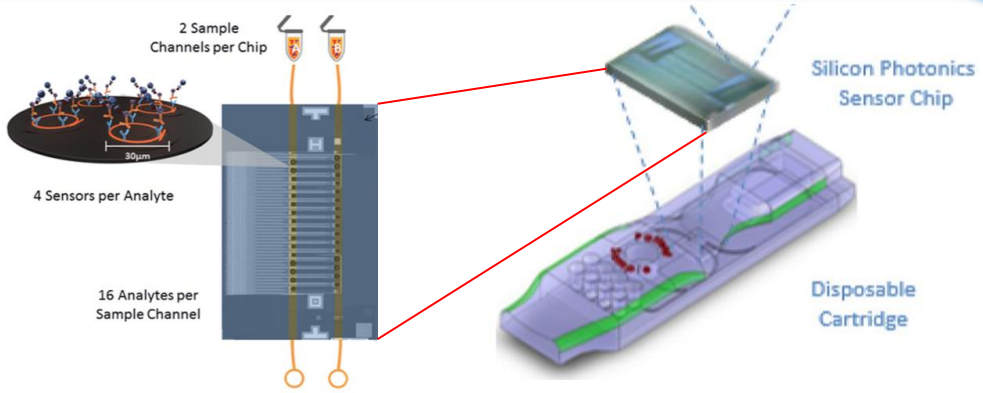
Biosensors and Bioelectronics 27 (2011) 101– 105



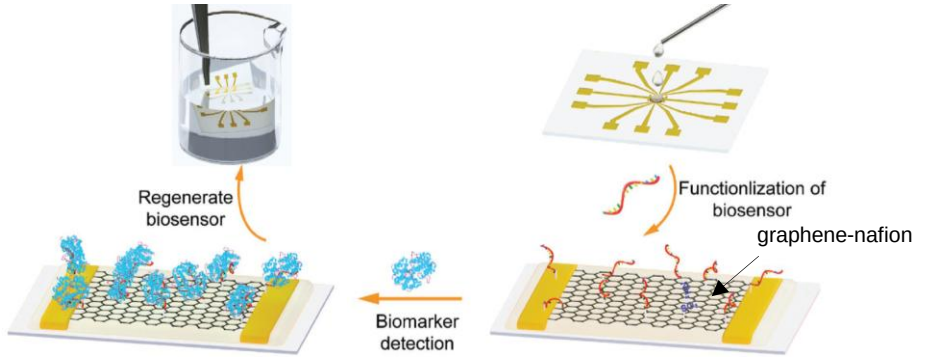
Lab Chip, 2011, 11, 1372

Inkjet printed bioreceptors

- ❑ Multiplexing with micro-resonators
- ❑ Economical use of reagents



Journal of Immunological Methods 448 (2017) 34–43 (Genalyte, Inc.)



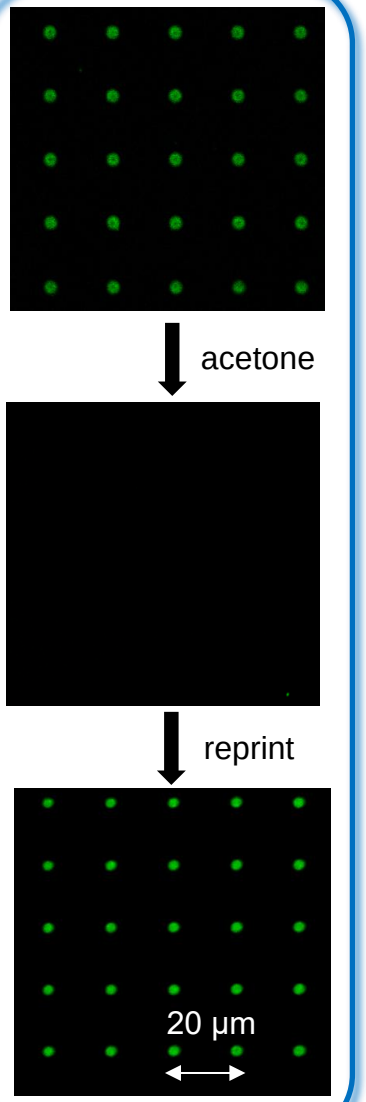
Adv. Funct. Mater. 2021, 31, 2005958

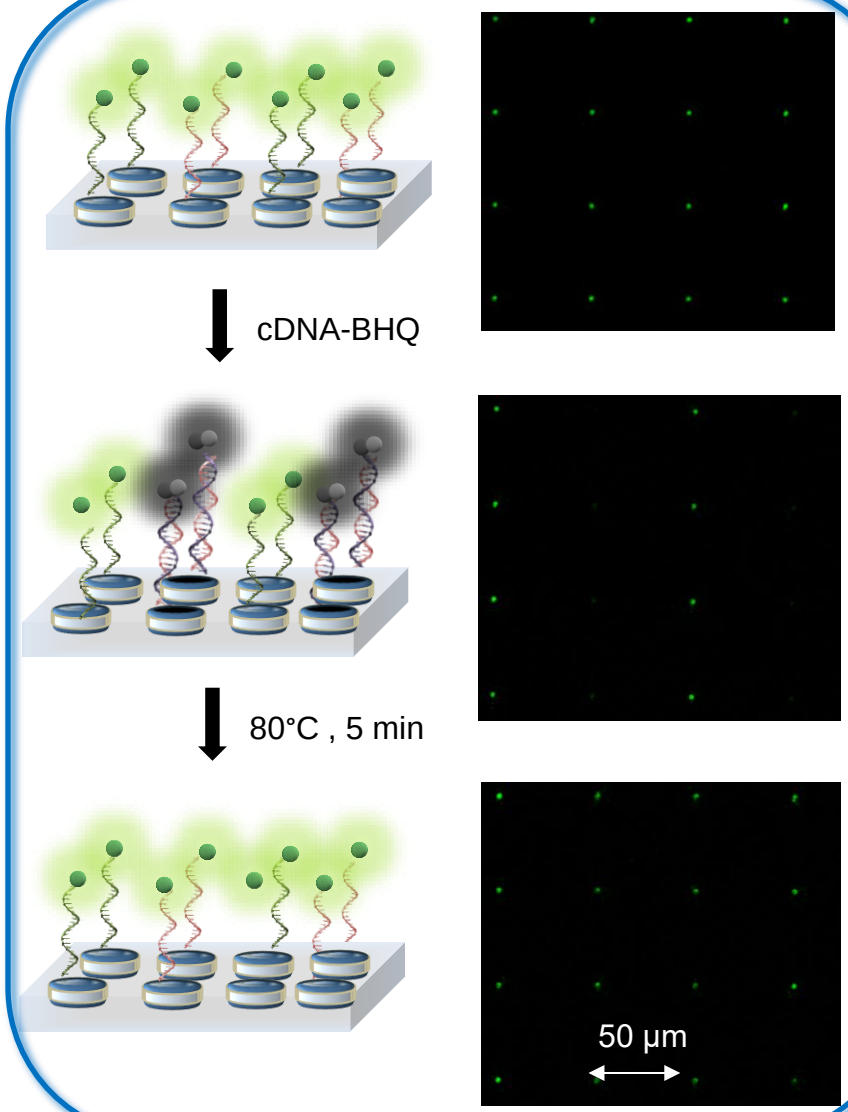
Regenerative biosensor

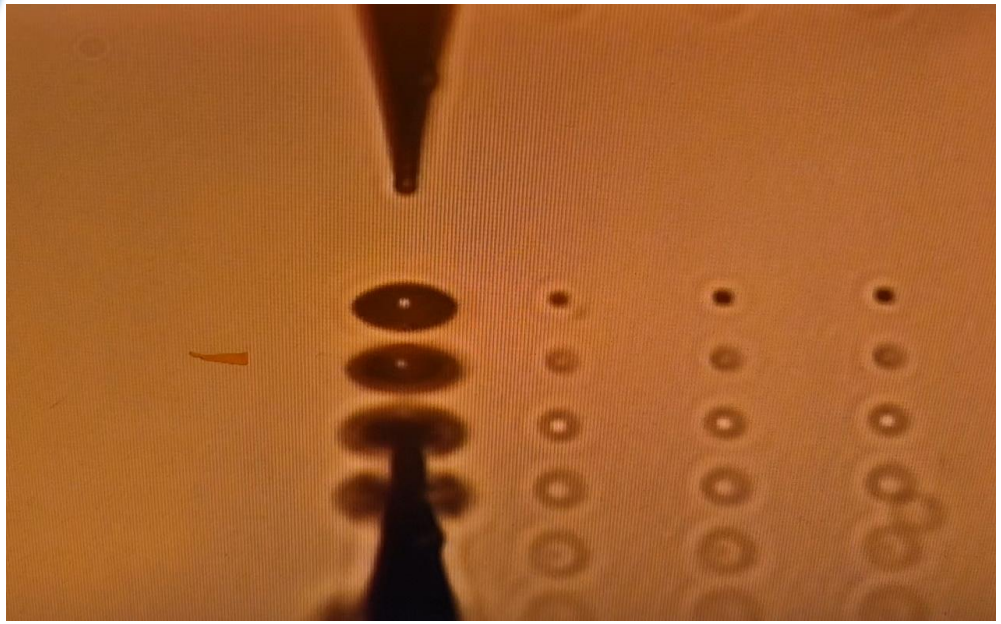
- ❑ Reusability
- ❑ Functionalization on-demand

© Hitachi, Ltd. 2025. All rights reserved.

EHD printing of functional polymer for biosensing



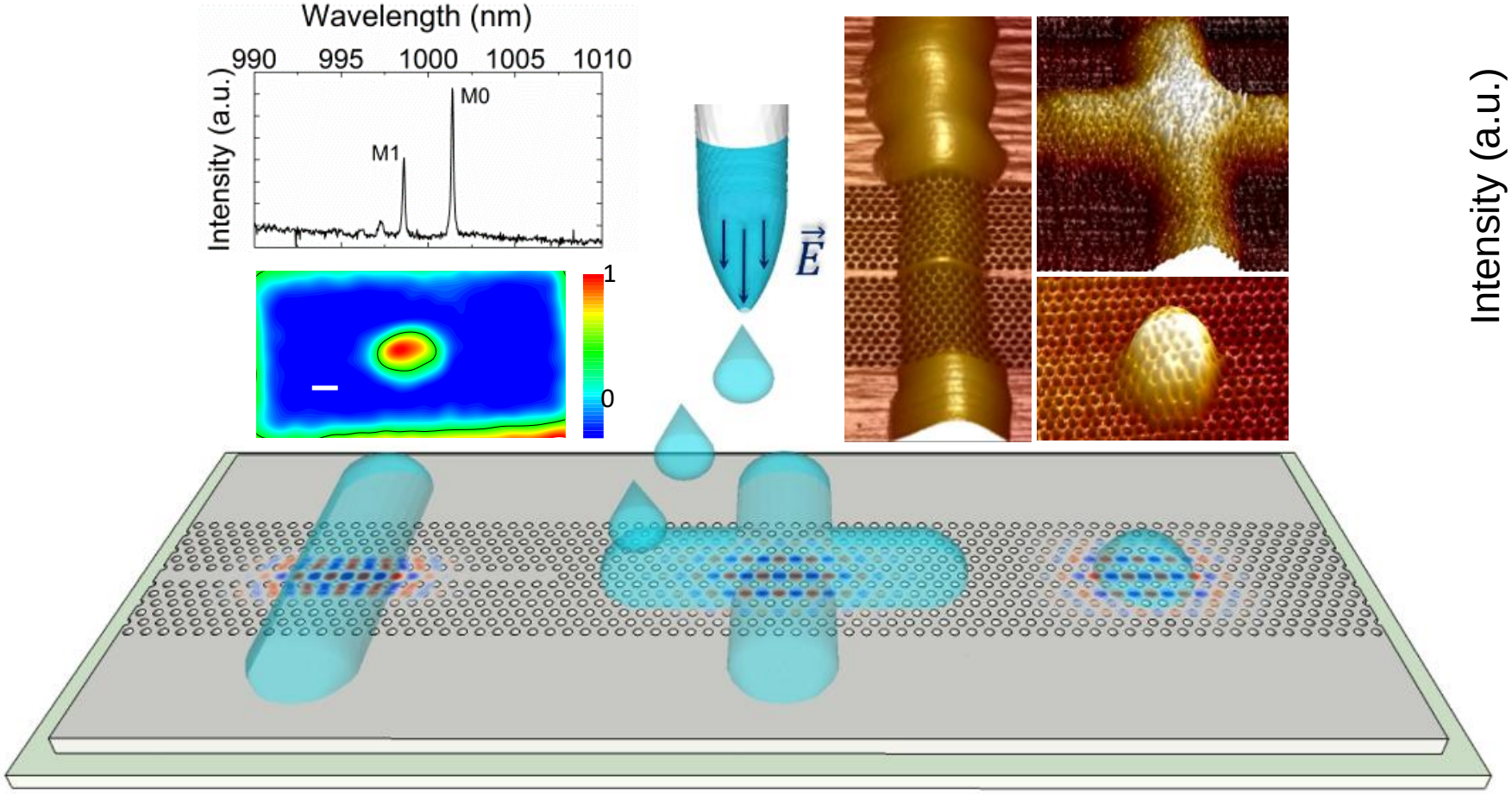


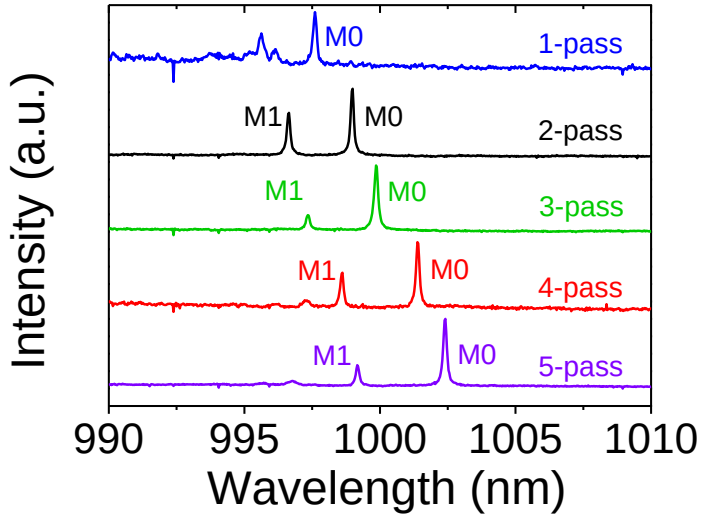


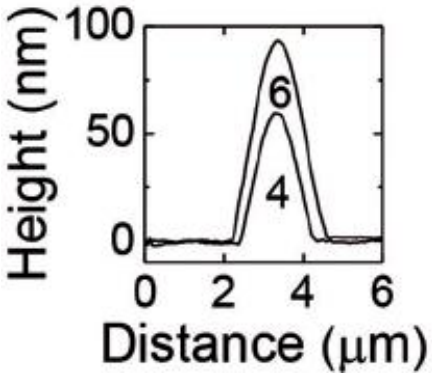
- ❑ Local
- ❑ Specific
- ❑ Repeatable
- ❑ Economical

© Hitachi, Ltd. 2025. All rights reserved.

EHD printing



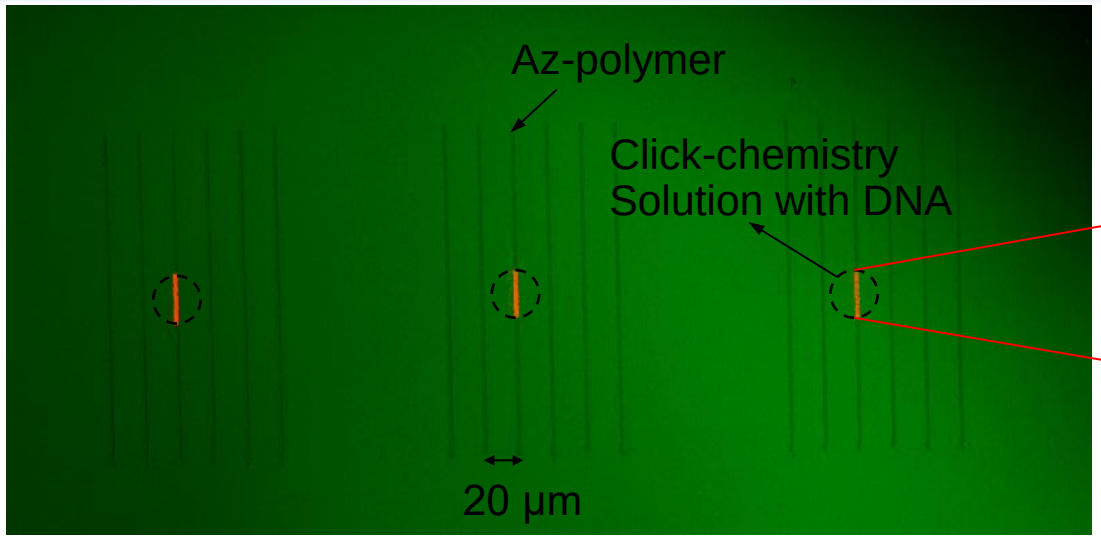


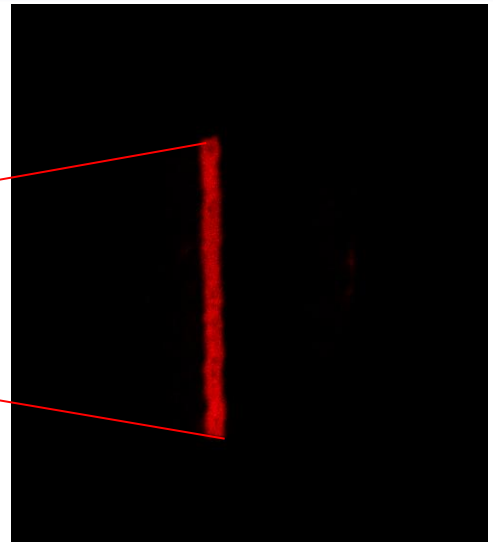


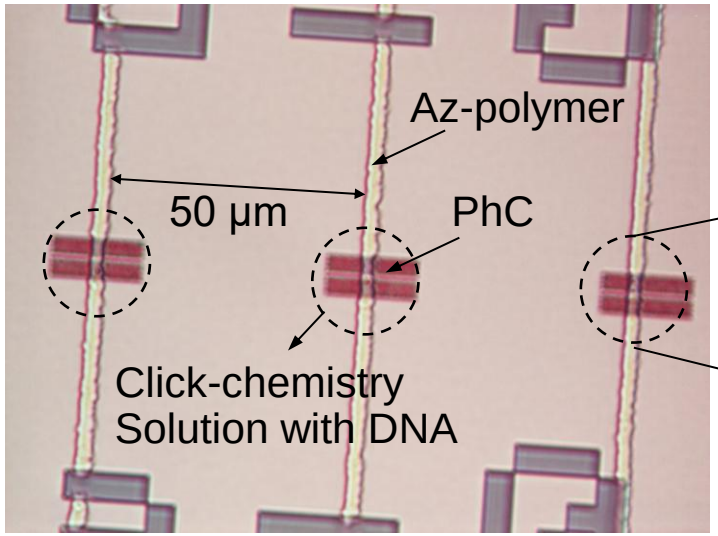
Adv. Mater. 29(47), 1704425 (2017)

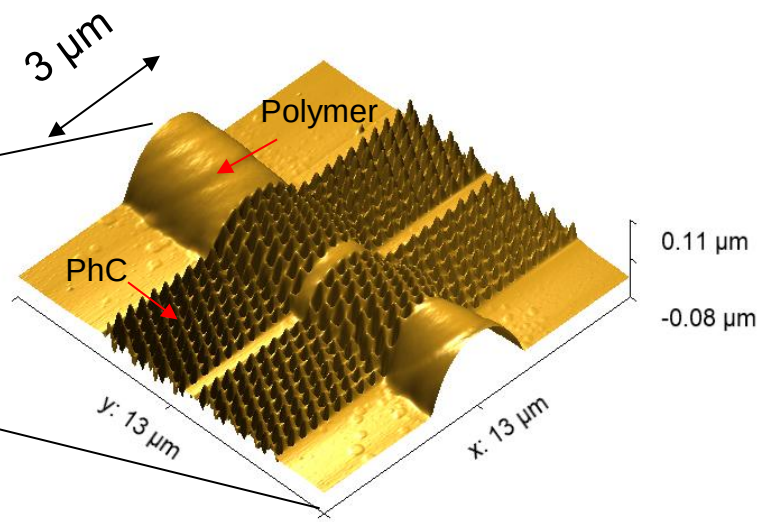
© Hitachi, Ltd. 2025. All rights reserved.

Functionalizing the sensor



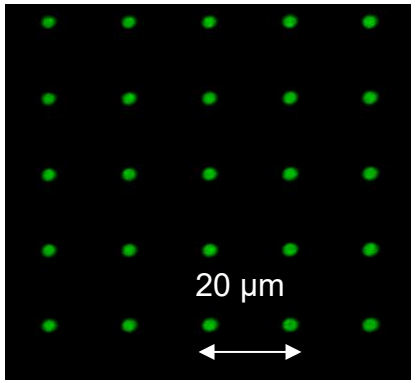


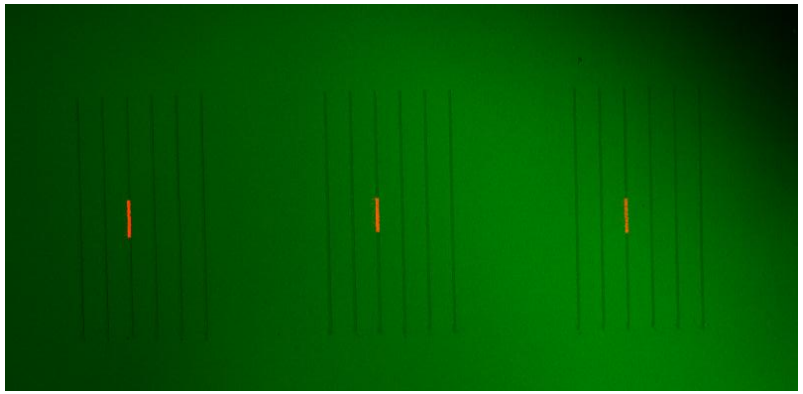




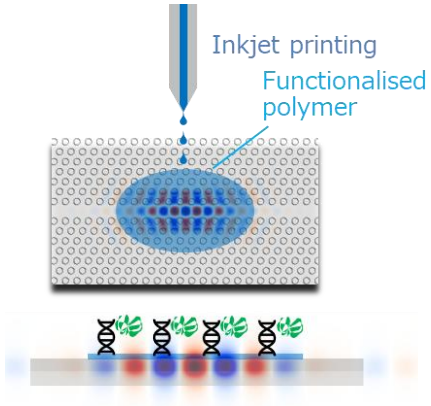
© Hitachi, Ltd. 2025. All rights reserved.

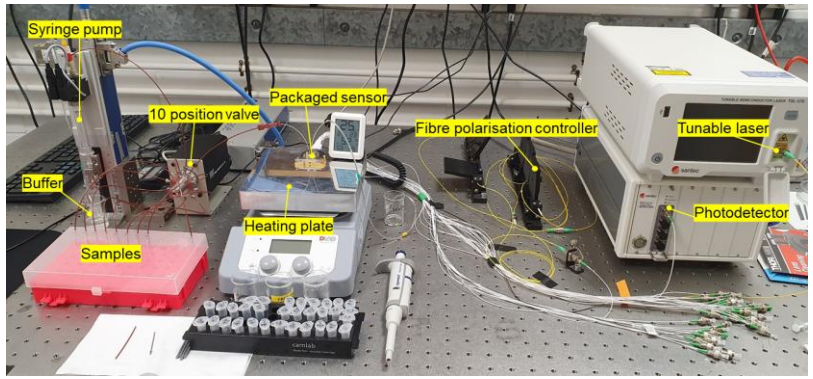
Potential offer/demand





- Fine sensor coating for dense multiplexed biosensing





- Integration of additive manufacturing (printing) with lab-on-chip
- Integration of a tunable laser/photodetector on-chip

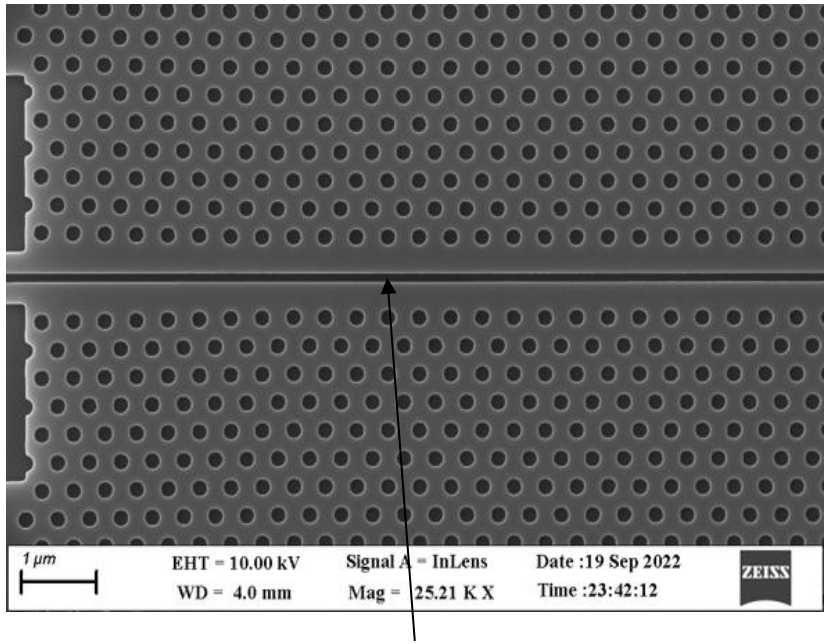
© Hitachi, Ltd. 2025. All rights reserved.

Hitachi Social Innovation is
POWERING GOOD

Suppl: PhC

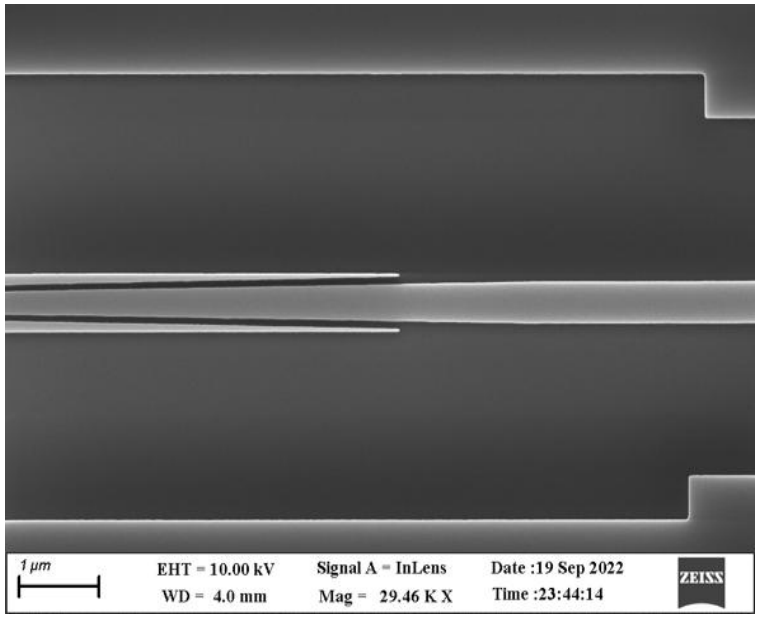
HITACHI
Inspire the Next

Photonic crystal



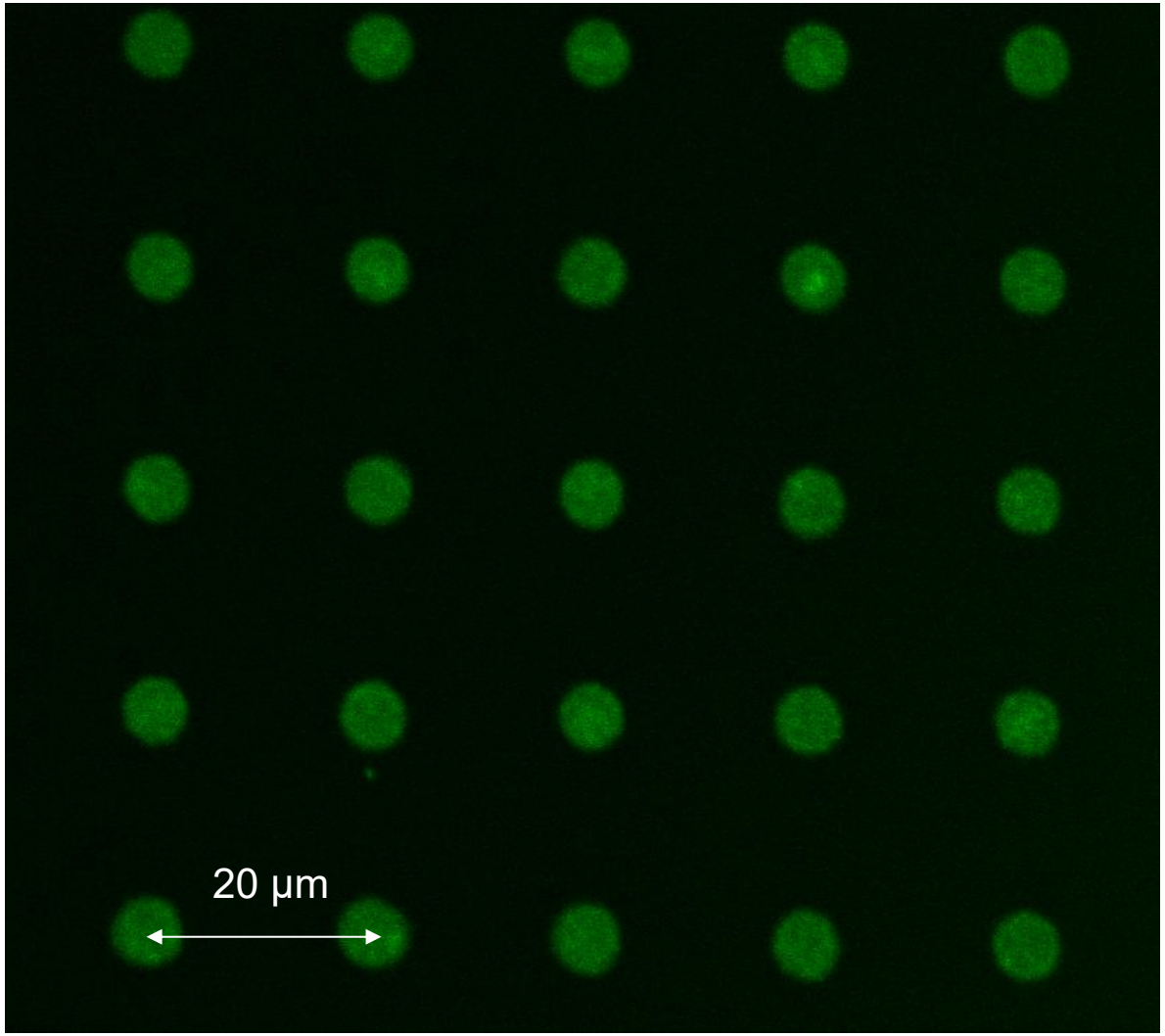
Nanoslot

Mode converter



© Hitachi, Ltd. 2025. All rights reserved.

Suppl: Dot uniformity



© Hitachi, Ltd. 2025. All rights reserved.