First developments towards TiO_2 nanoimprint for photonic sensor fabrication

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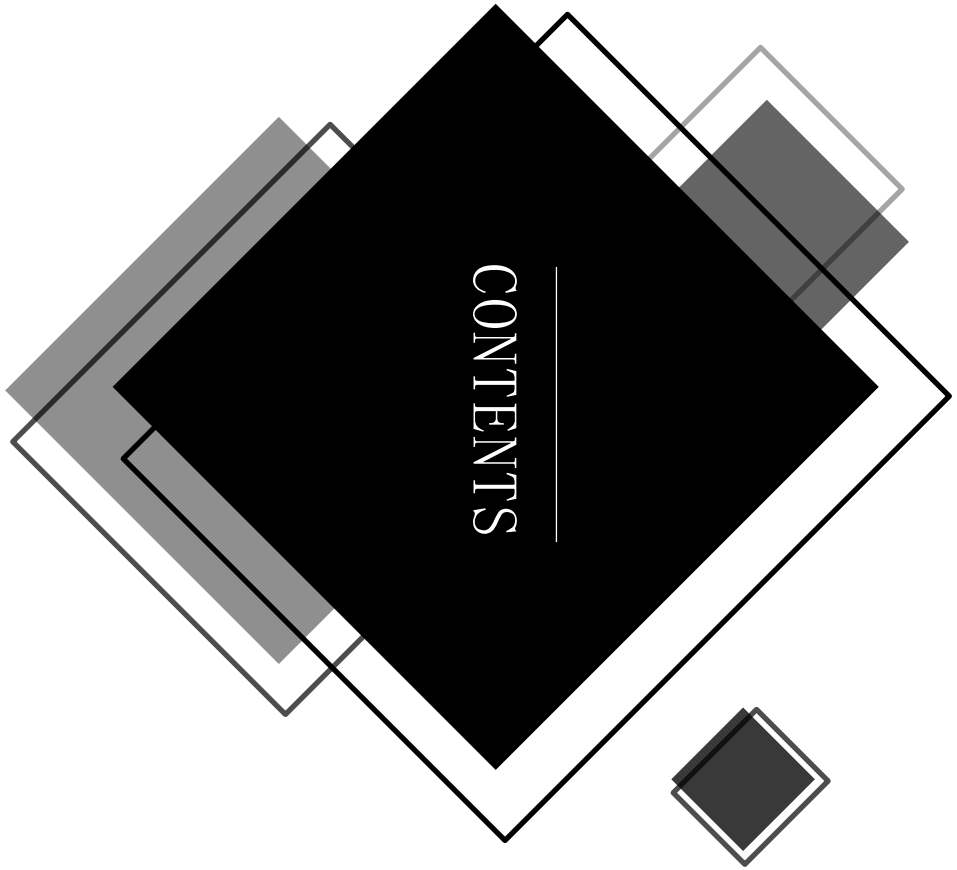

- Context and objectives
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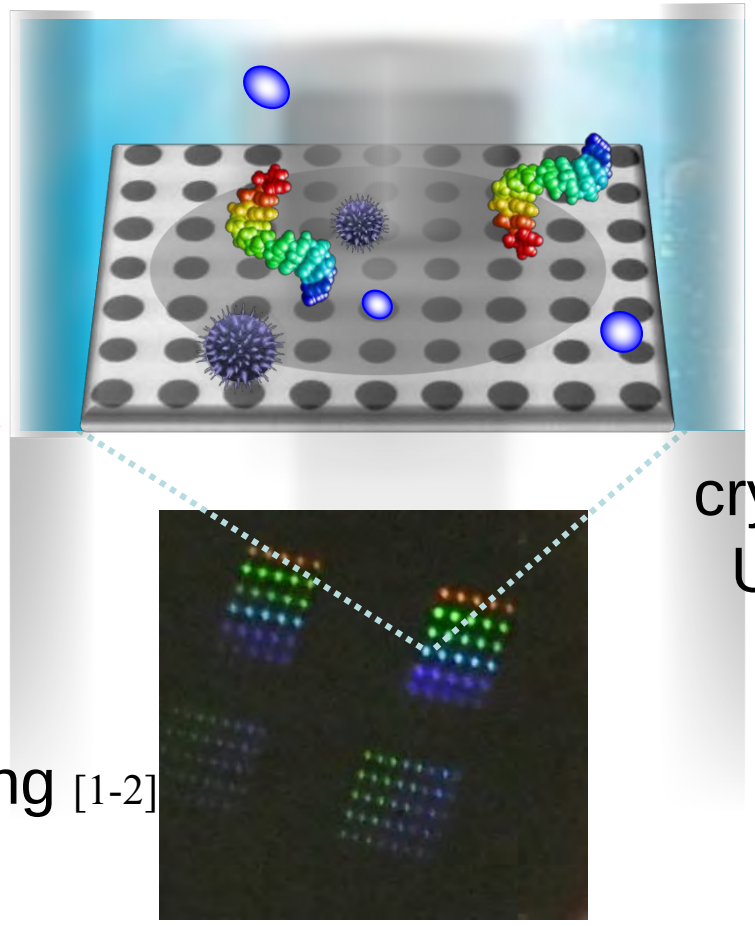
- Conclusion & Future work

Context and objectives

New photonic sensors for single-use point-of-care diagnostics/monitoring tools:

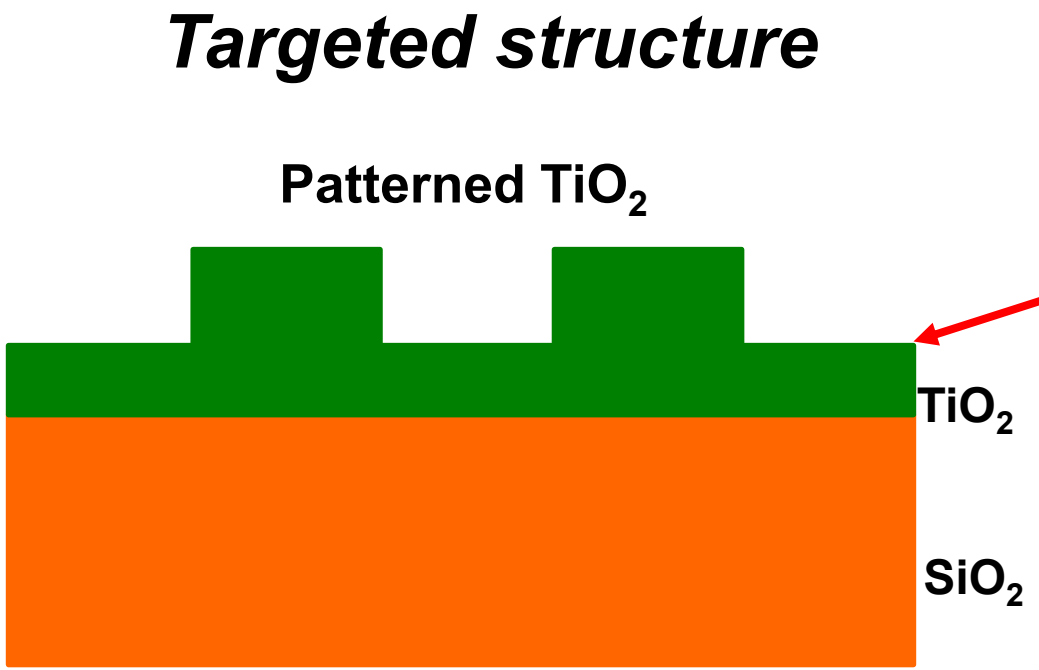
cost-effective
low environmental impact
high-throughput biomolecular screening [1-2]

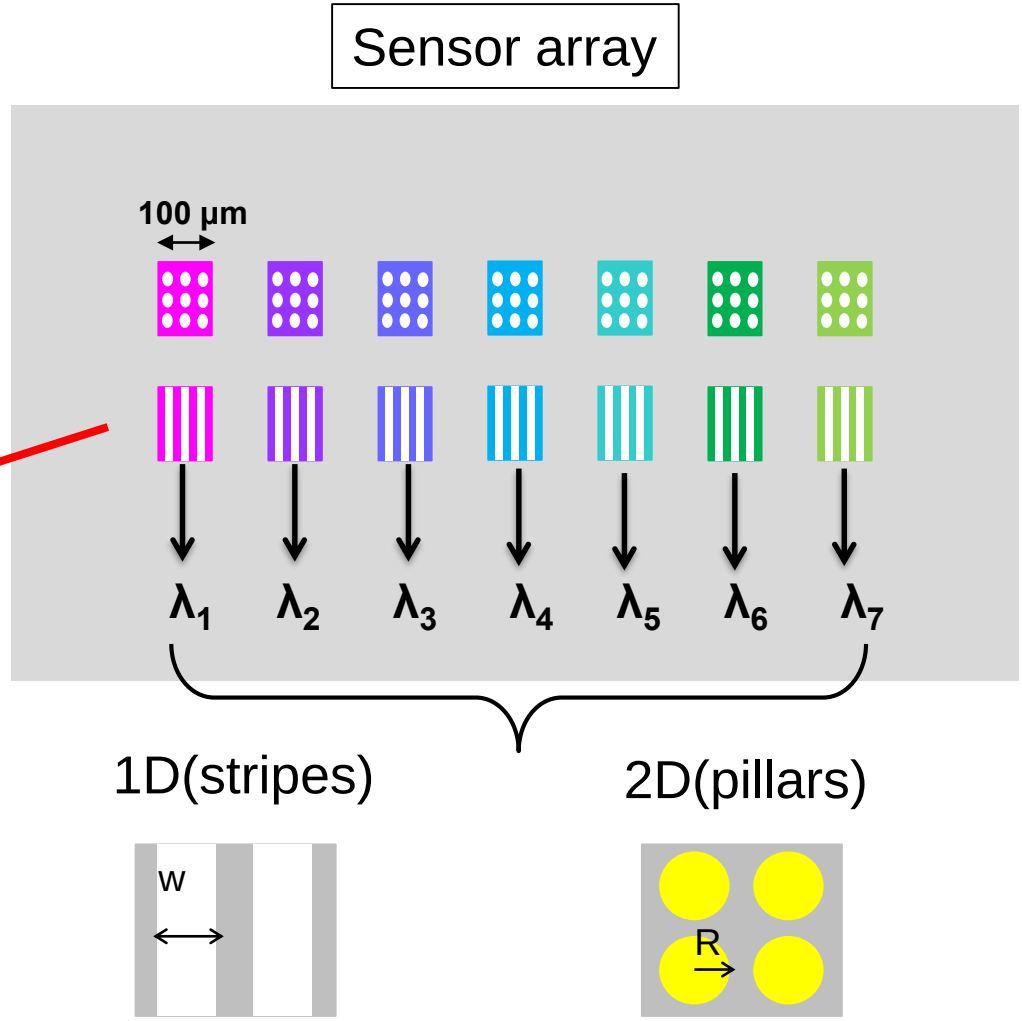


TiO_2 photonic crystal sensors via UV-Nanoimprint

[1]Fenzl, *et al*, Angewandte Chemie International Edition 53.13(2014):3318-3335.
[2]Heeres, J. T., *et al*, Cheminform 40.8(2011):4398-4410.

Targeted structure





Varying period, a = 400-1000nm;
filling factor, ff=0.1-0.3

Main process of TiO_2 nanopatterning

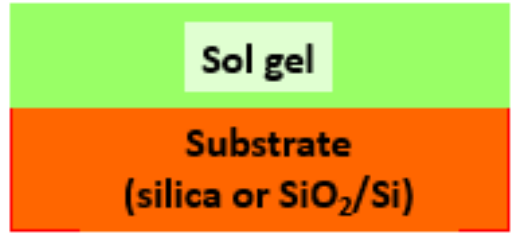
1. Fabrication of master

Lithography (e-beam), Al deposition and lift-off

2. Fabrication of PDMS stamp

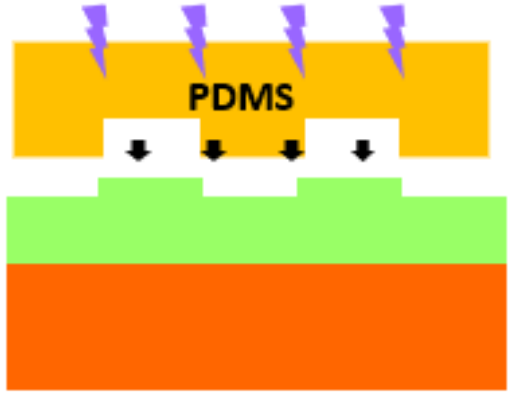
PDMS moulding using Si master

3. Spin coating of sol gel solution



4. Nanoimprint

Press + UV illumination

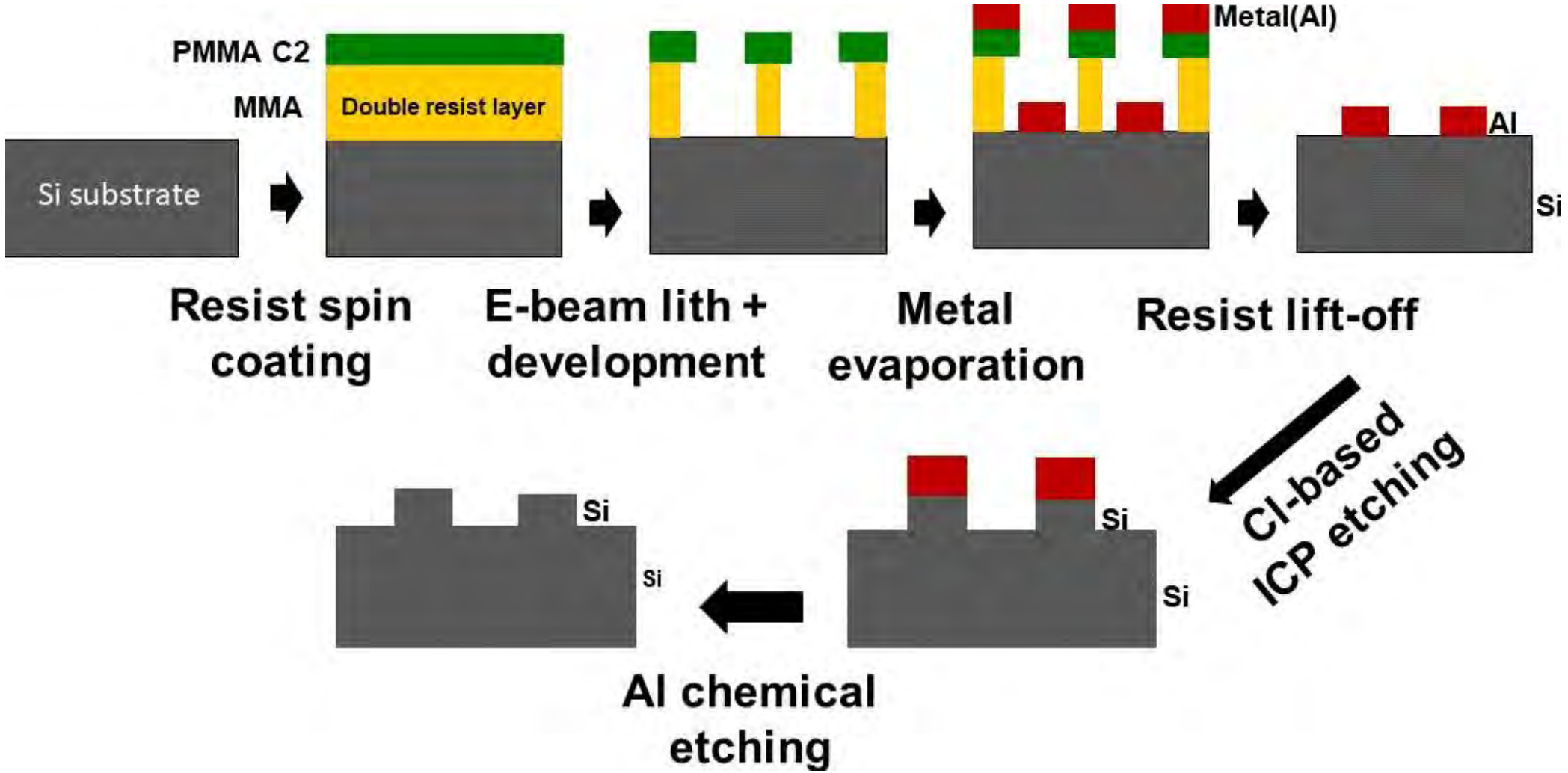


5. Final structure

(after TiO_2 crystallisation)

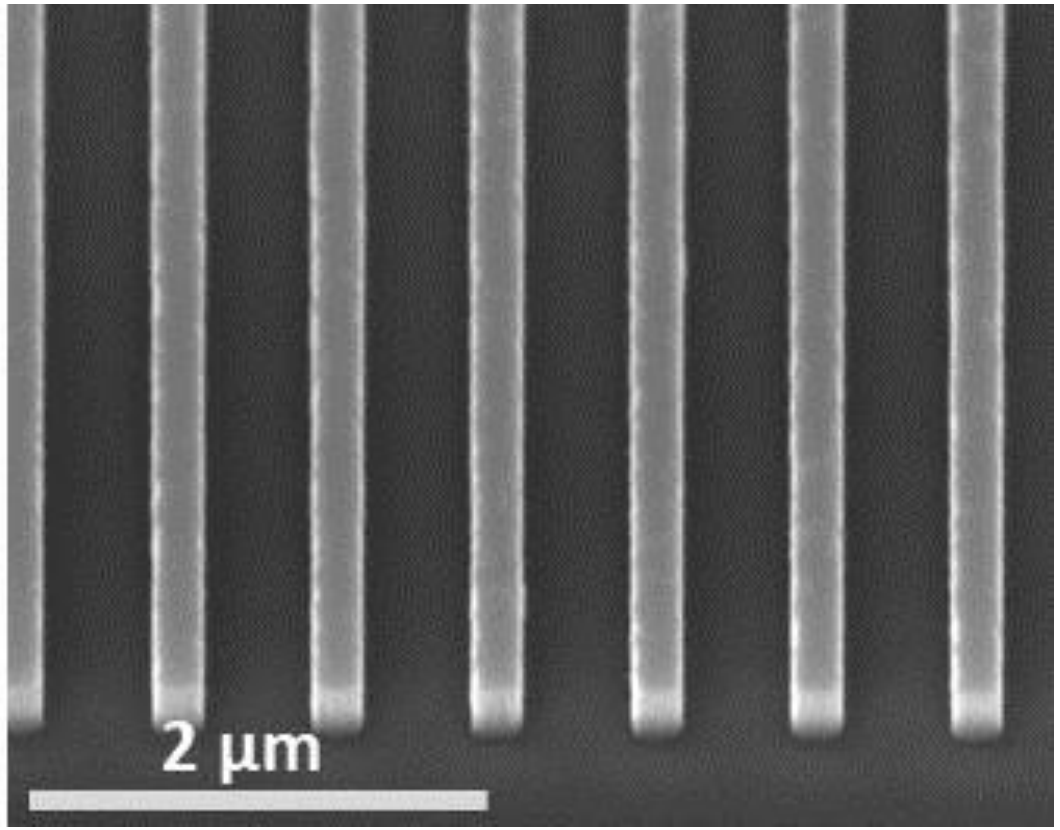
Master fabrication

Fabrication of Si pillars ⟶ Positive resist combined with lift-off

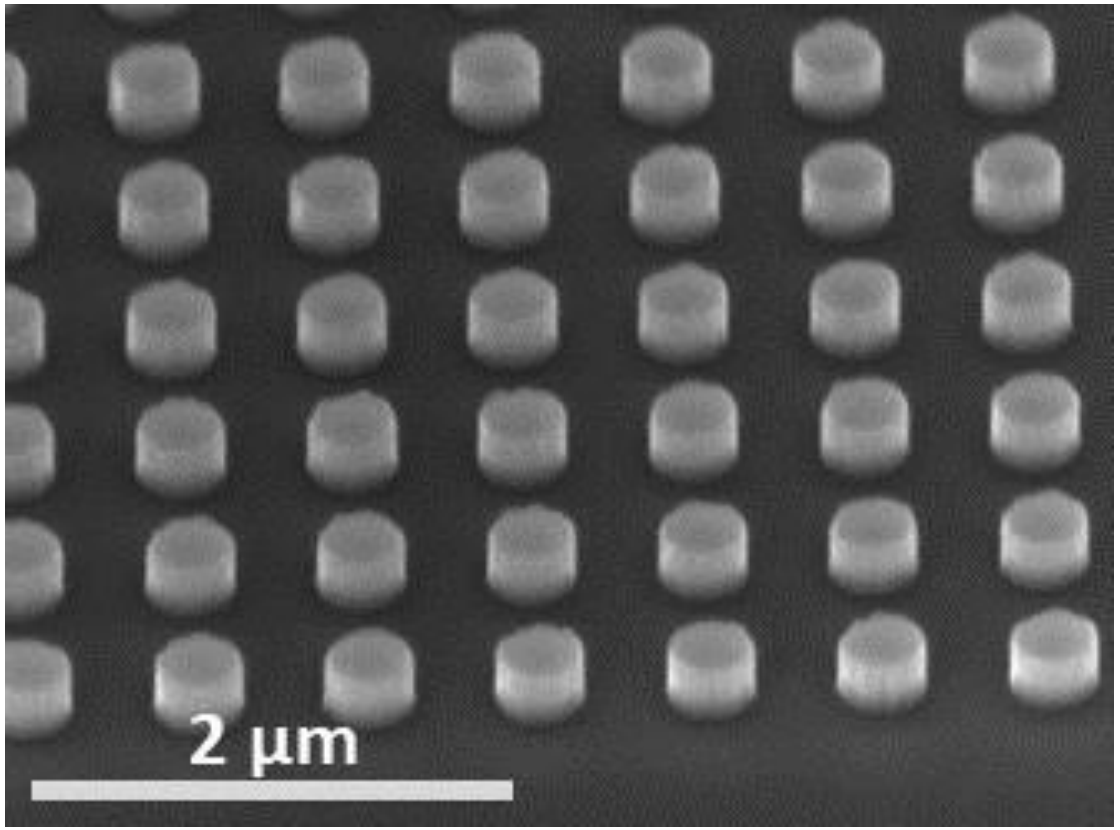


Master fabrication

Master fabrication Successful !! ☻

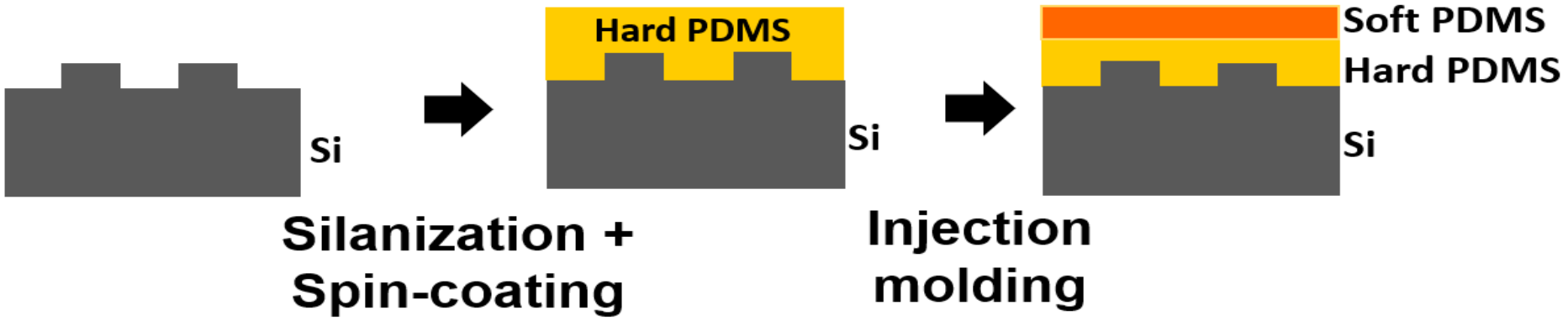


Profile view 1D



Profile view 2D

Fabrication of PDMS stamp



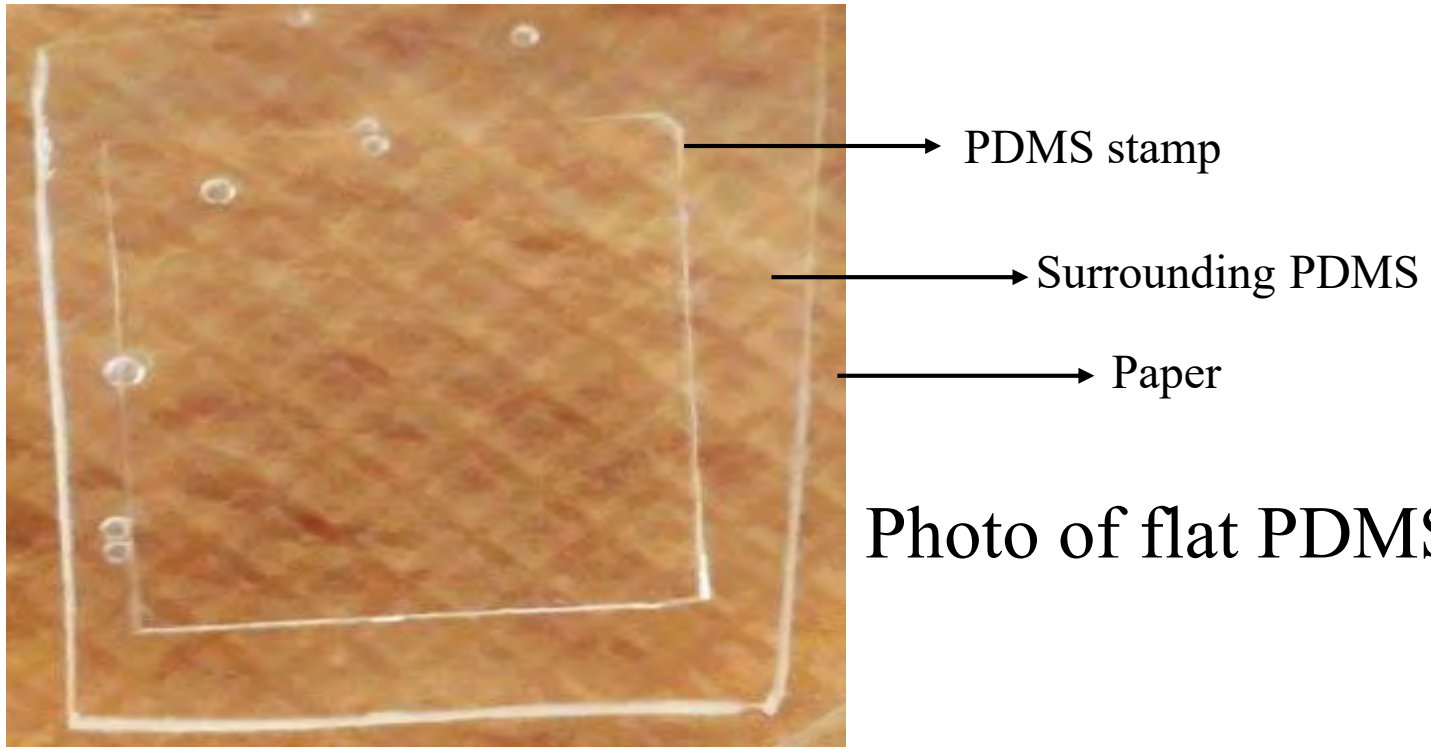
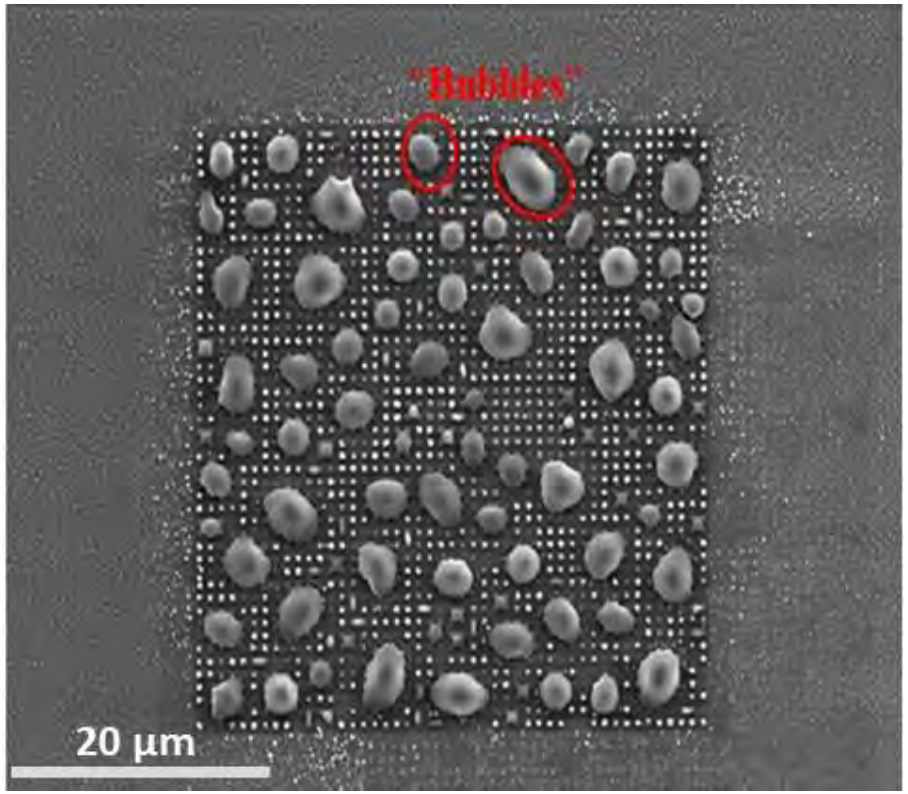


Photo of flat PDMS stamp

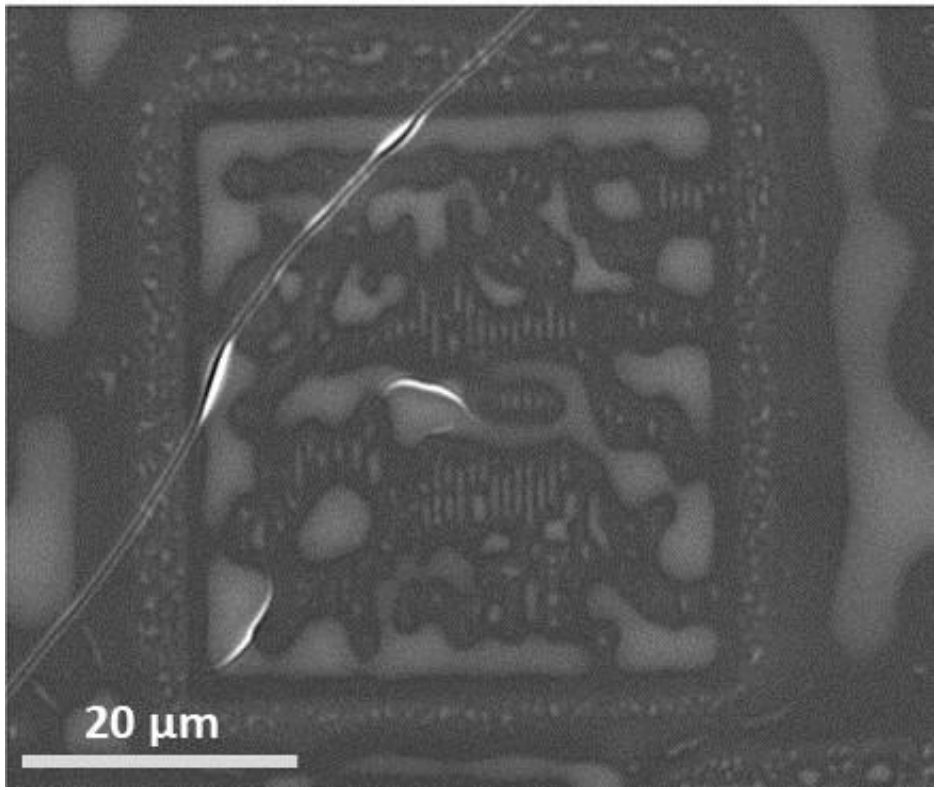
What can go wrong?

😯 Problem with silanization



Si master with Al patterns
after PDMS moulding

🤯 Reaction with Al probably due to HCl release



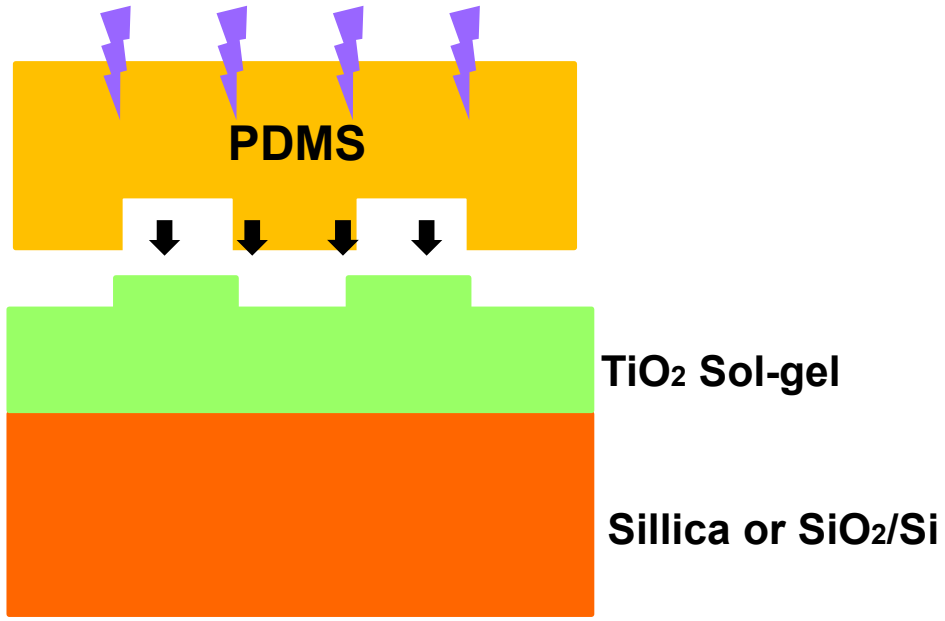
Nanoimprinted TiO_2 pattern

➡ **Remove the Al before silanization**

Coming soon: Nanoimprint

Nanoimprint

Press + UV illumination



TiO_2 sol-gel: alcoholic Benzoylacetone-modified sol [3]
(provided by LHC, Laboratoire Hubert Curien in Saint-Etienne)

Equipment: NPS 300

[3]Briche, S. , et al, Journal of Materials Science 46.5(2011):1474-1486.

Conclusions & future works

So far…

- ✓ The master stamp was successfully fabricated
- ✓ The master fabrication process was re-optimized for compatibility with PDMS moulding.
- ✓ The thickness of TiO_2 obtained was basically about 300 nm(before nanoimprint).

Next…

- ➢ Optimization of patterned PDMS stamps & nanoimprinting
- ➢ Fabrication and optical characterization of the devices
- ➢ Sensing experiments (glucose solutions and protein sensing)

Acknowledgments

Colleagues

CHINA SCHOLARSHIP COUNCIL

INSA

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Lyon 1

THANKS FOR YOUR ATTENTION!