Development of set-up, fluidic system and protocol to functionalize and characterize optical fibers in the context of biosensors.

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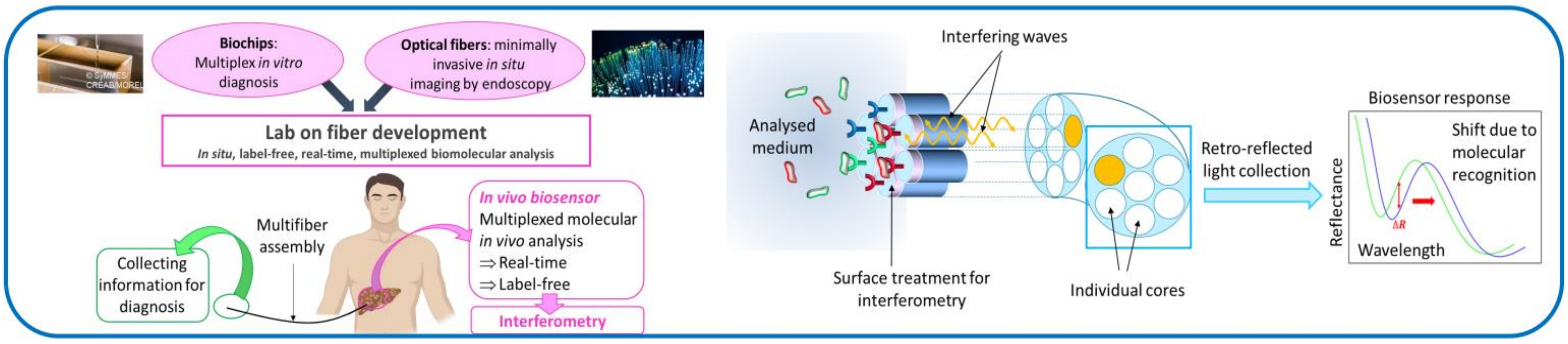
Scientific context



Objectives

1. Develop a surface functionalization protocol and a set-up, suitable for micro-metric area spotting.

2. Develop a fluidic device to enhance fiber characterization results.

Surface functionalization protocol and set-up

Surface chemistry protocol

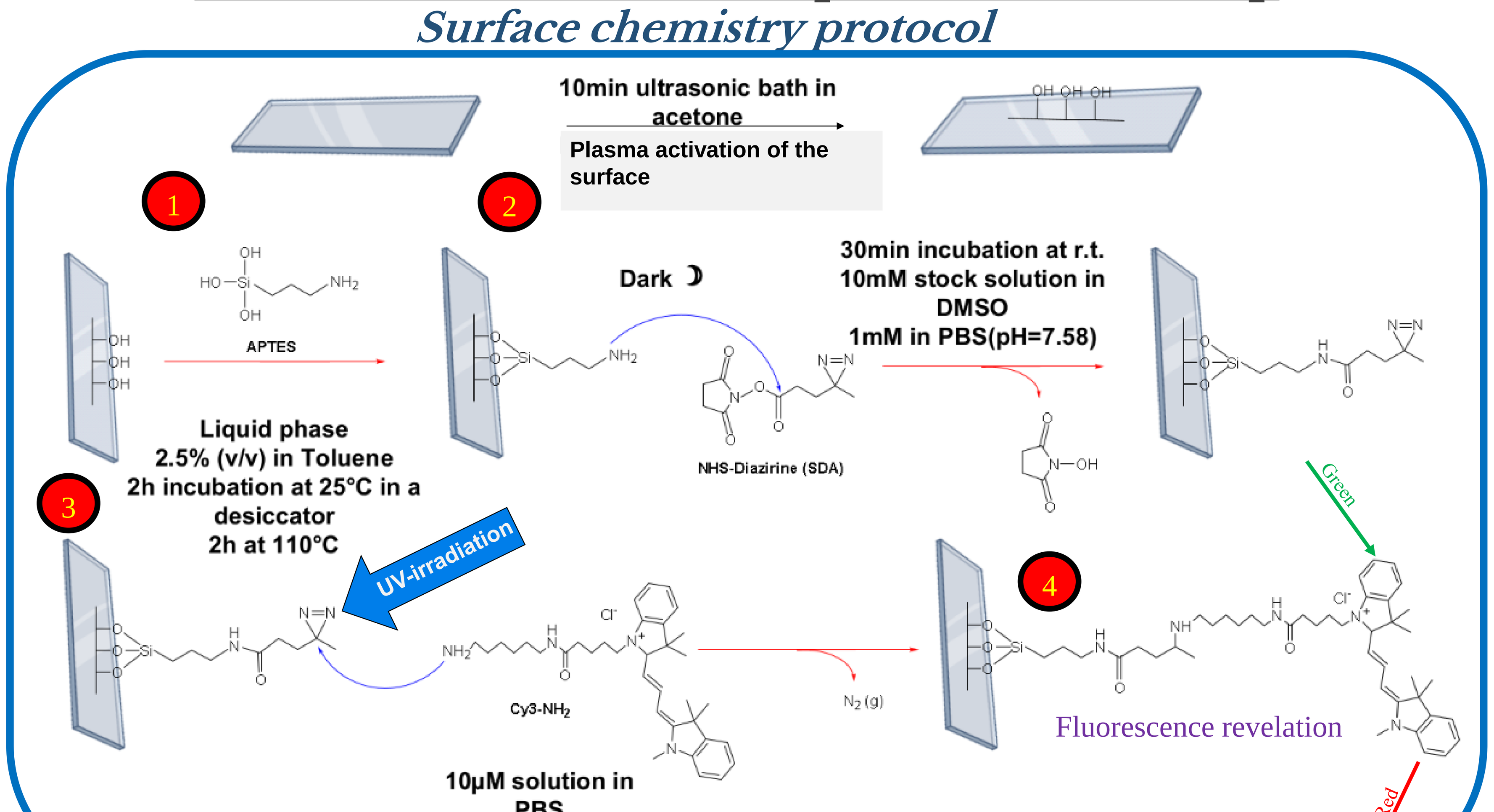


Figure 1 - Schematic representation of the chemical and optical aspects of the developed functionalization protocol

1. Silanization: attachement of **APTES** to the glass-slide.
2. Binding of photo-sensitive linker, **NHS-Diazirine** [3].
3. UV-irradiation for fluorophore (**Cy3-amine**) grafting.
4. Fluorescence revelation under the microscope.

Results

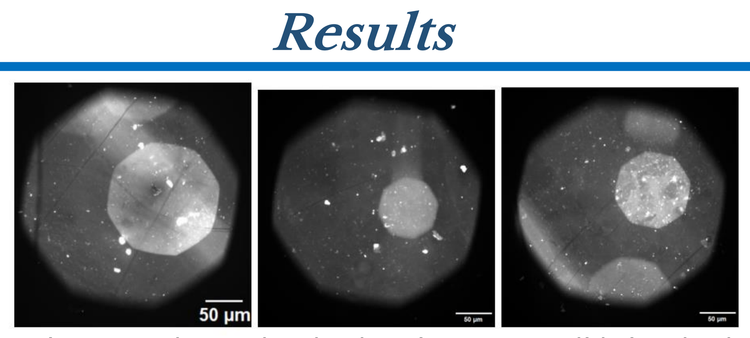


Figure 2 Cy3 amine spots observed under the microscope, validating the developed protocol.

- ➢ Cy3-amine detection **only** on UV-irradiated spots.
- ✓ Validation of the developed grafting protocol

Functionalization set-up

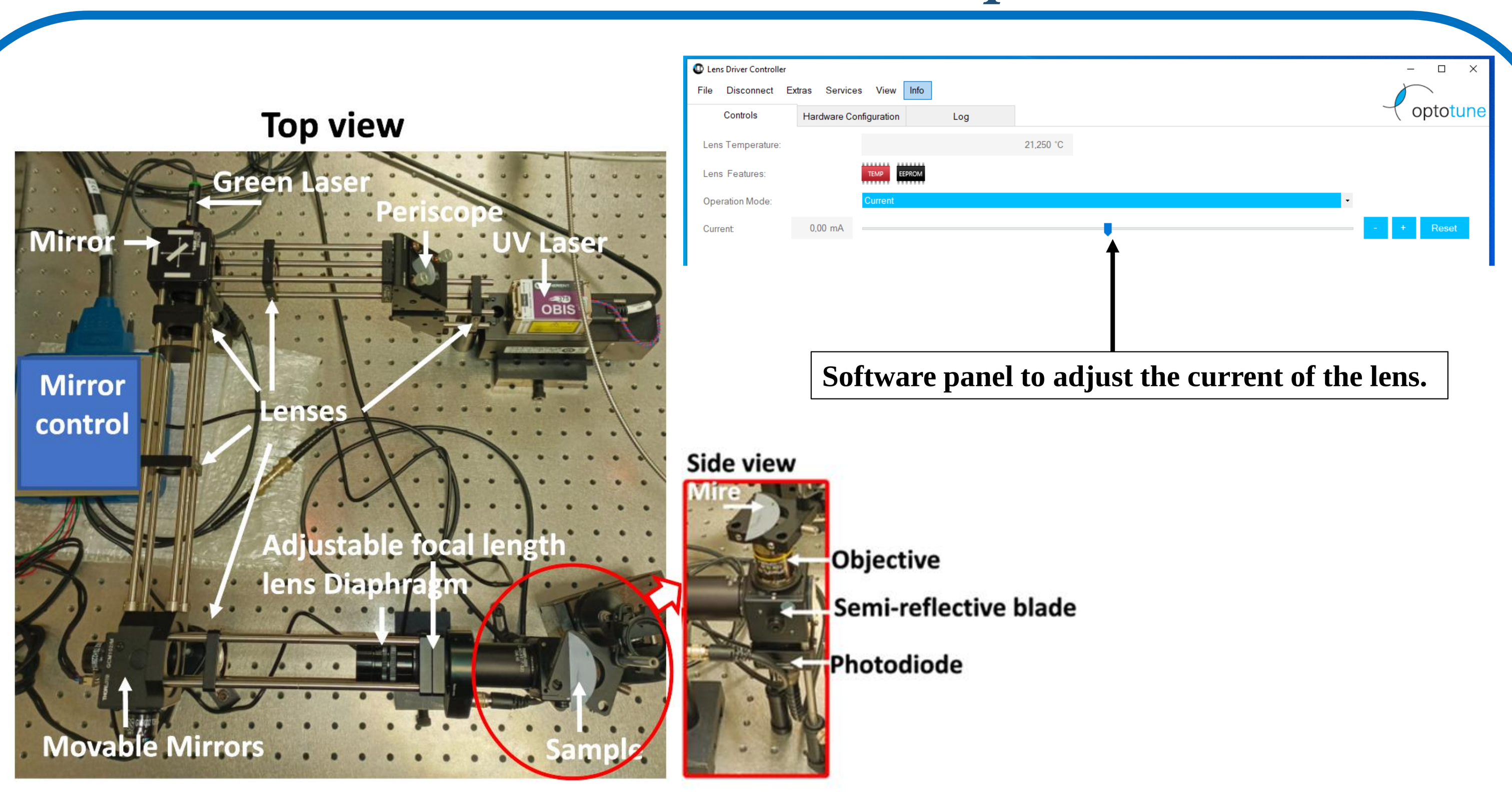


Figure 3 Set-up built by the team to perform localized UV irradiation.

- ➢ Control of the focal lens length by current adjustment (see controll pannel).
- ✓ Ability to focus on the sample with both lasers in the setup (*UV* and *red* laser)*****.

*The UV laser is used to photo-activate diazirine, while the red laser is used to image the surface of the sample.

Fluidics for characterization

Device preparation

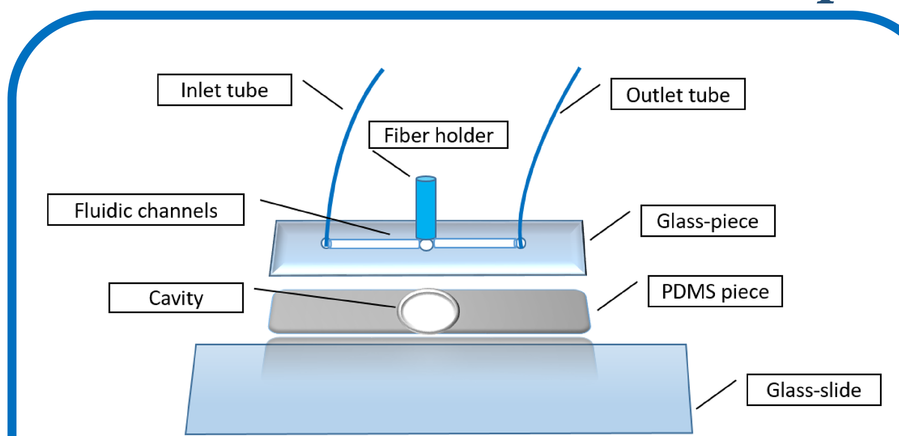


Figure 4 Fluidic device developed for the characterization set-up.

1. Poly(dimethylsiloxane) (**PDMS**) production.
2. Manual drilling of PDMS, forming a cavity.
3. Drilling an inlet, outlet, and a fluidic channel in the glass-piece.
4. Glass/PDMS plasma gluing.

Fluidic set-up integration to the characterization set-up

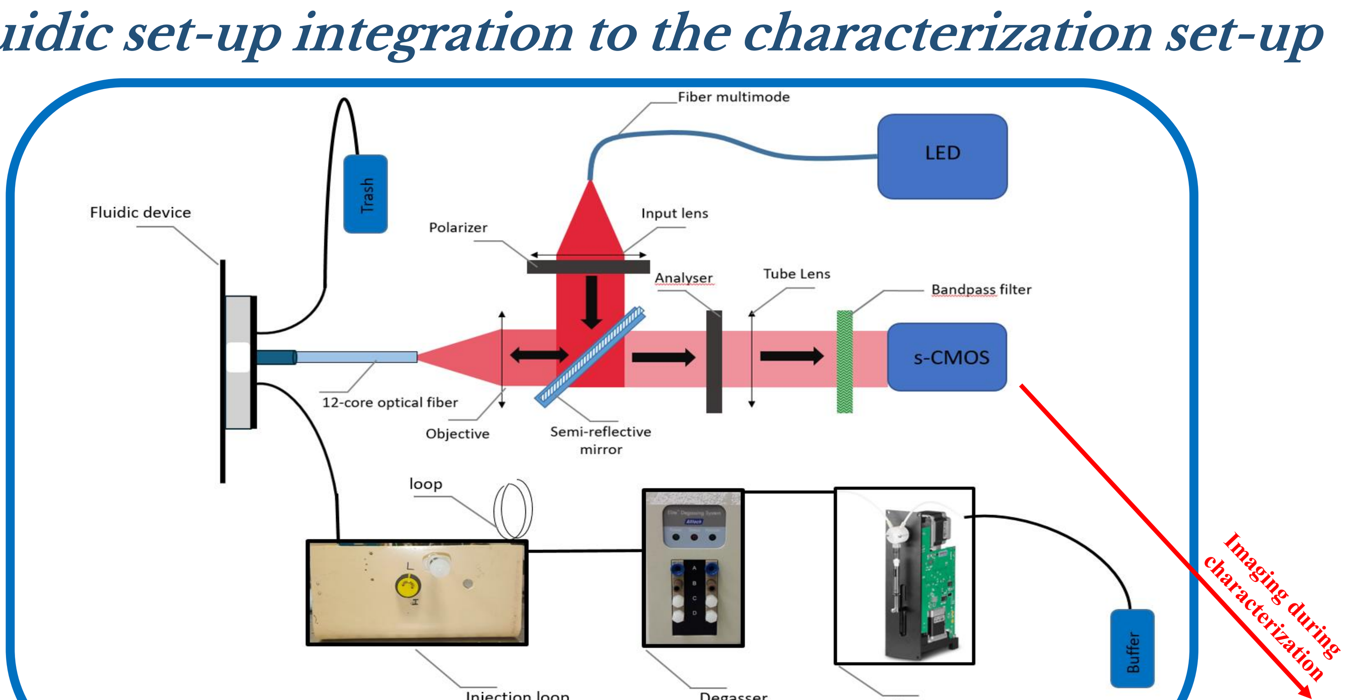
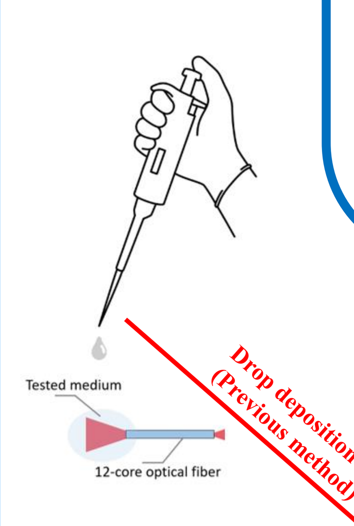
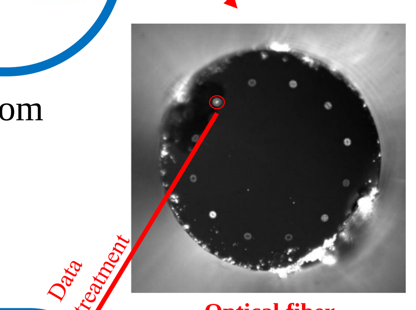


Figure 5 Characterization set-up after fluidics integration.

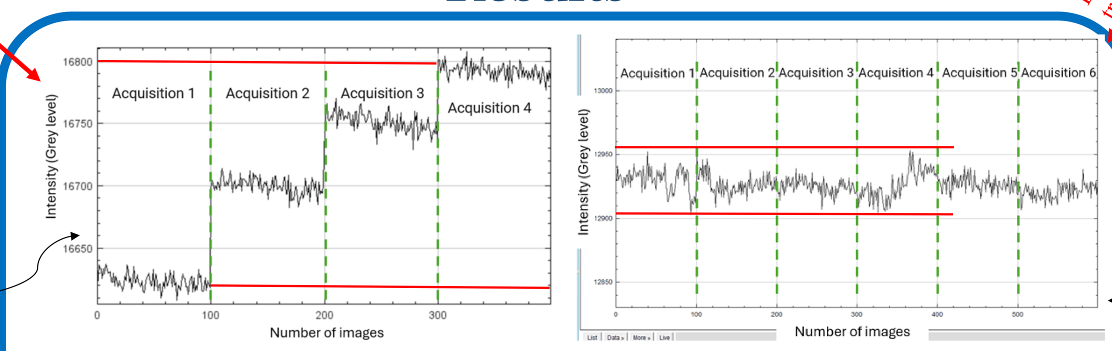




- ➢ Fluidic system assembled to run the developed fluidic device (bottom part of **figure 5**).
- ➢ Fluidic system integrated to the set-up used by the team for fiber characterization.

Results

$$\% \frac{\Delta I}{I} = \frac{16800 - 16610}{16610} \times 100$$



$$\% \frac{\Delta I}{I} = \frac{12960 - 12910}{12910} \times 100$$

Figure 6 Characterization result comparison of one of the fiber's cores, before and after (left to right) implementing the fluidic device .

- ✓ Improvement of characterization results reproducibility. Percentage error in intensity dropped from **1.14 %** to **0.39 %**.

Conclusion

- ✓ Proof-of-concept of the functionalization protocol done on a glass-slide.
- ✓ Operational fluidic device developed for characterization.

Perspectives

- ➢ Adapt the functionalization protocol for DNA (and Protein) grafting.
- ➢ Perform bio-detection of complementary DNA to validate the protocol.
- ➢ Develop a fluidic device that is suitable for localized UV irradiation of fibers.
- ➢ Perform optical characterization with different optical index solutions to obtain sensitivities.

References

1. This Scientific Poster Template Is Provided By PosterNerd.
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3. Oleksii Bratash, Arnaud Buhot, Loïc Leroy, and Elodie Engel. Optical fiber biosensors toward in vivo detection. Biosensors and Bioelectronics, 251:116088, 2024.
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