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Water pollution sensor using microalgae and xurography-based microfluidic chips

Antoine GOSSET^{1,3*}, Louis RENAUD^{2*}, Claude DURRIEU¹, Rémy BAYARD³, Jean-François CHATEAUX^{2*}

¹Université de Lyon, ENTPE, CNRS, UMR 5023 LEHNA, 3 Rue Maurice Audin, 69518 Vaulx-en-Velin, France
²Université de Lyon, Institut des Nanotechnologies de Lyon INL-UMR5270, Université Lyon 1, Villeurbanne, F-69622, France
³Université de Lyon, INSA-Lyon, Laboratoire DEEP, Bât. S. Carnot, 9 rue de la Physique, F-69621 Villeurbanne, France

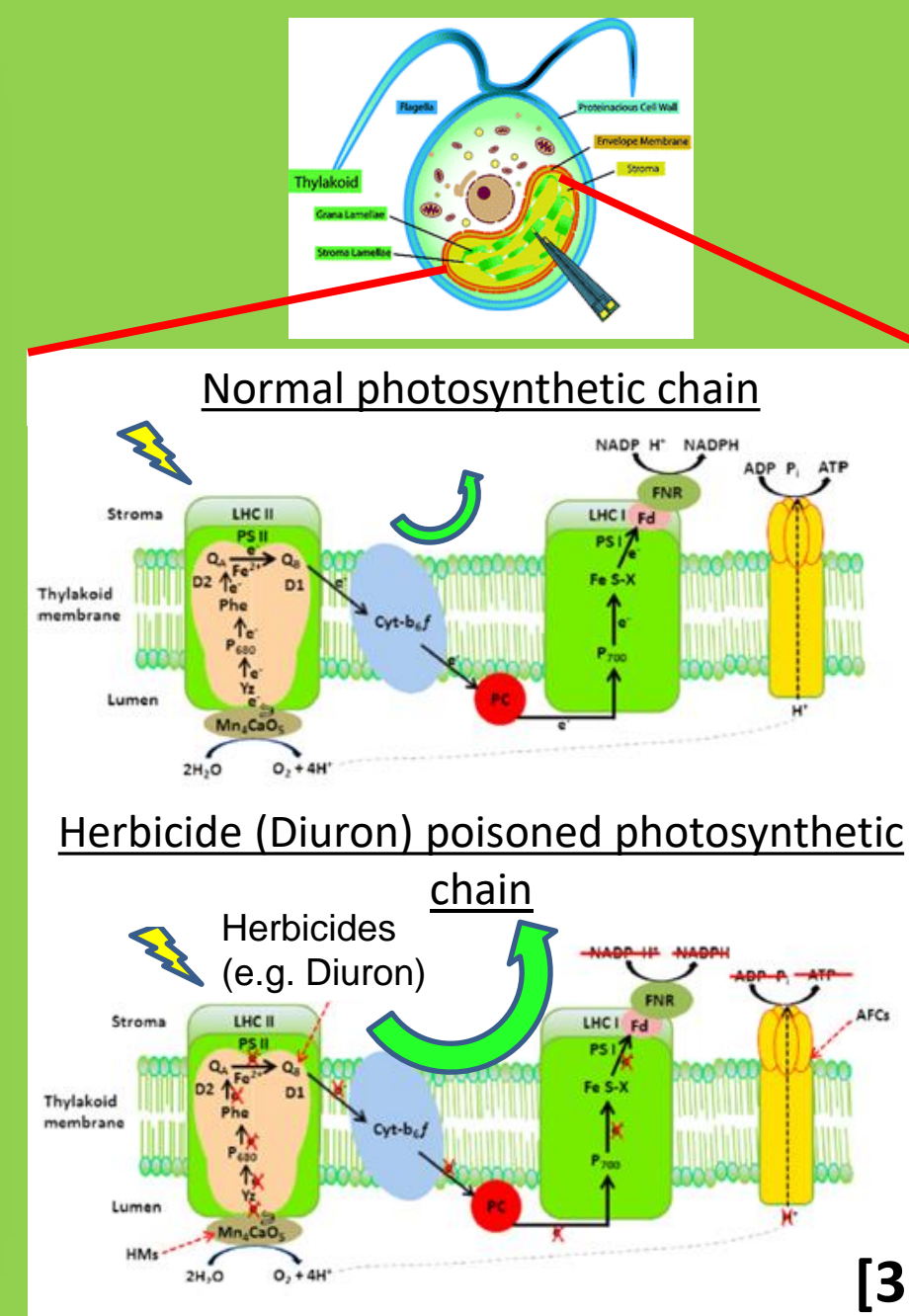
*corresponding authors : antoine.gosset@entpe.fr ; louis.renaud@univ-lyon1.fr ; jean-francois.chateaux@univ-lyon1.fr

Introduction

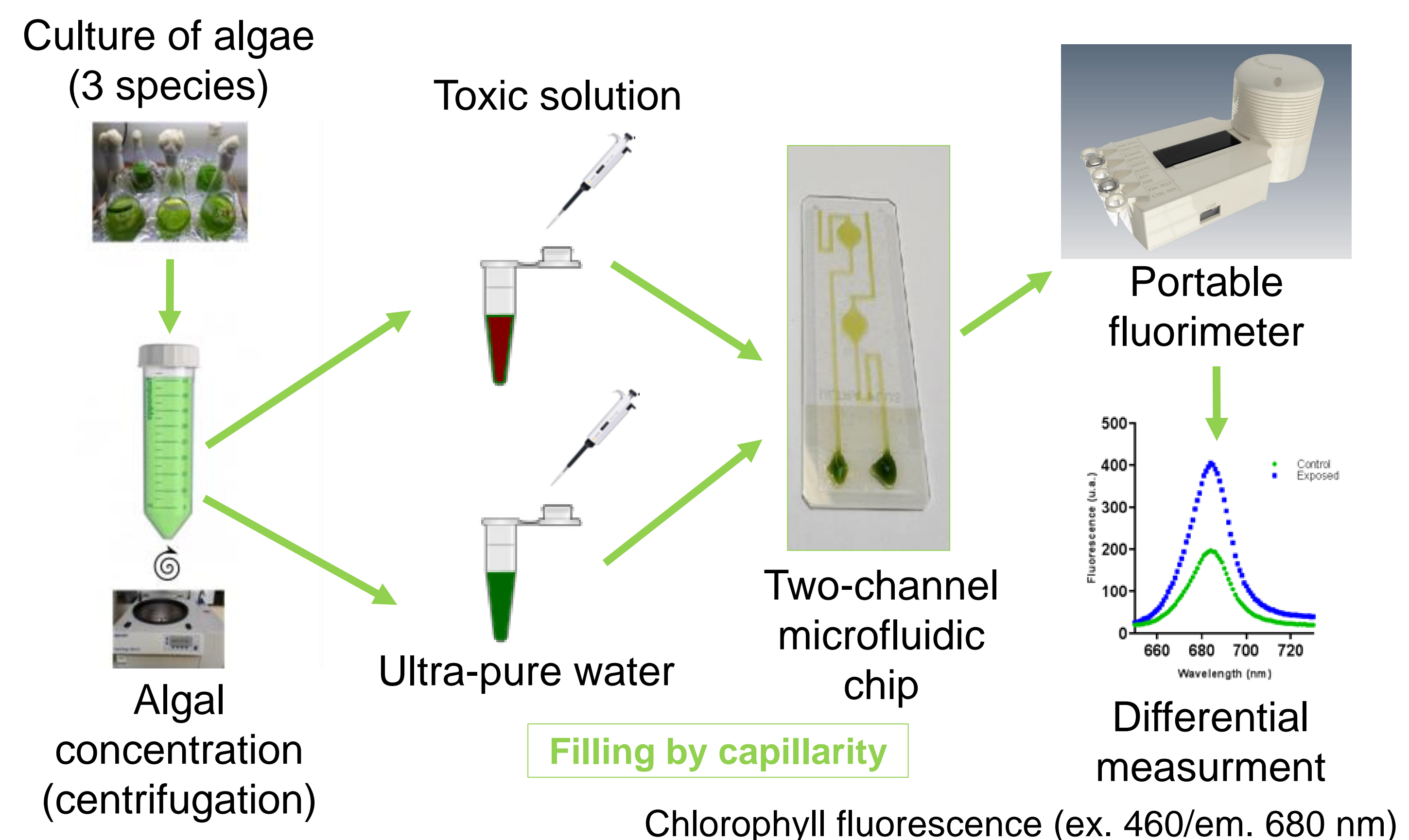
- Urban wastewaters (e.g. stormwaters): a source of many ecotoxic micropollutants for aquatic ecosystems [1].
- Algal biosensors are very promising tools for the measurement of potential toxic discharges, using photosynthetic activity disturbance (chlorophyll fluorescence) [2].
- Current barriers to their effective use: algal immobilization (e.g. with hydrogels, that lead to a low sensitivity and problems of reduced cell viability), variability of response and transportation on field (pumps).
- Microfluidics and xurography are very useful to overcome these technical problems (good volume control, no immobilization, miniaturization, low cost).

Objective

To develop (with a model pesticide, Diuron) an multi-algal biosensor employing ready-to-use xurography-based microfluidic chips and a dedicated fluorescence analysis system; and to apply this tool for the detection of toxic urban wastewater samples.

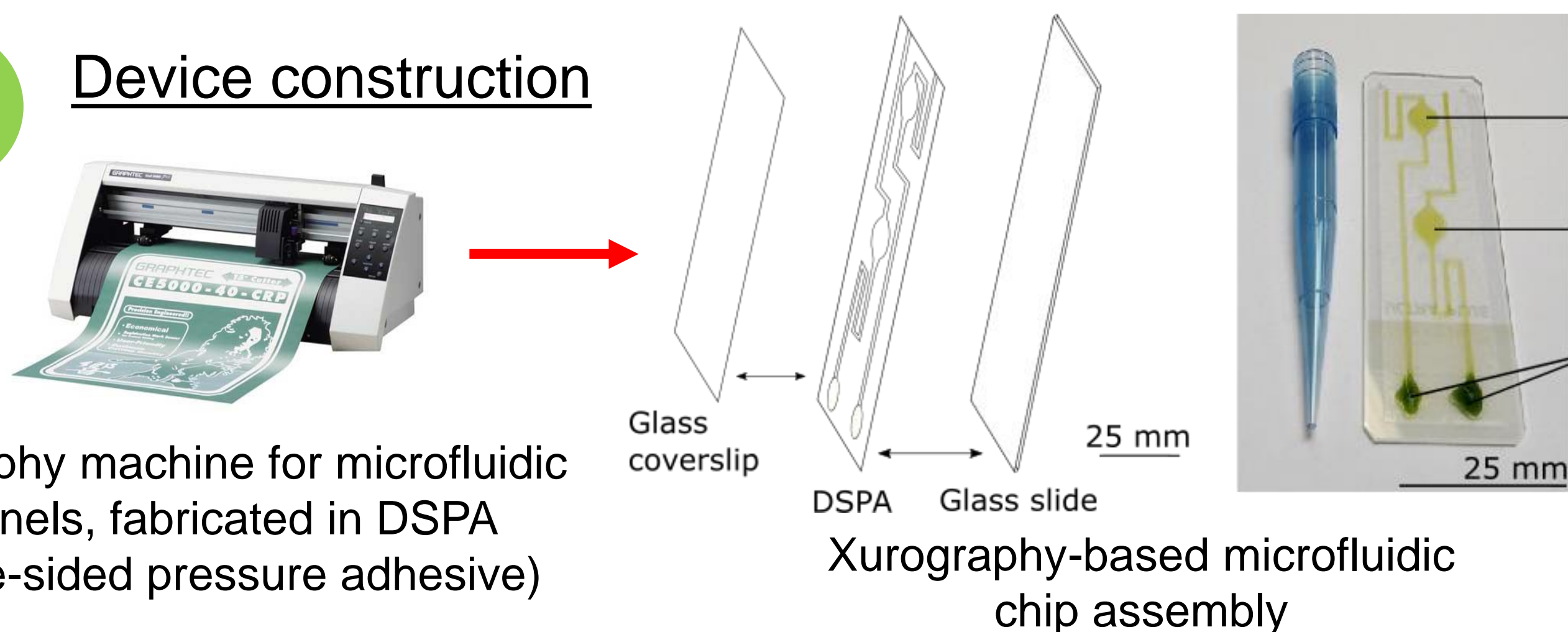


General principle of the sensor



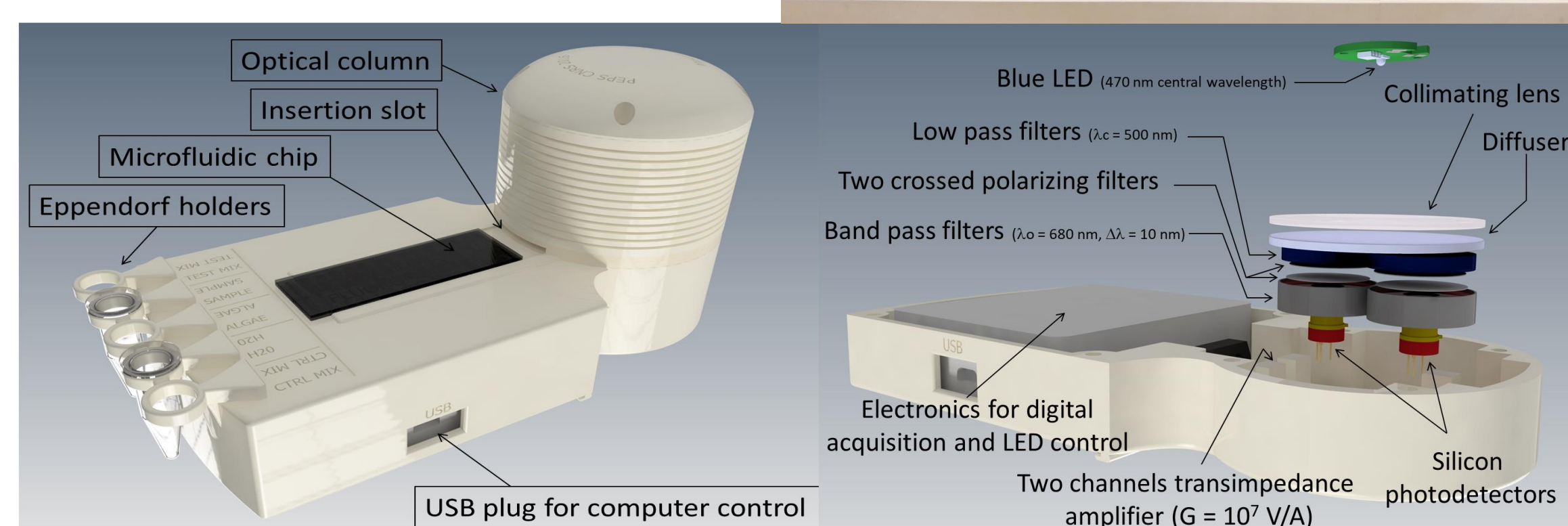
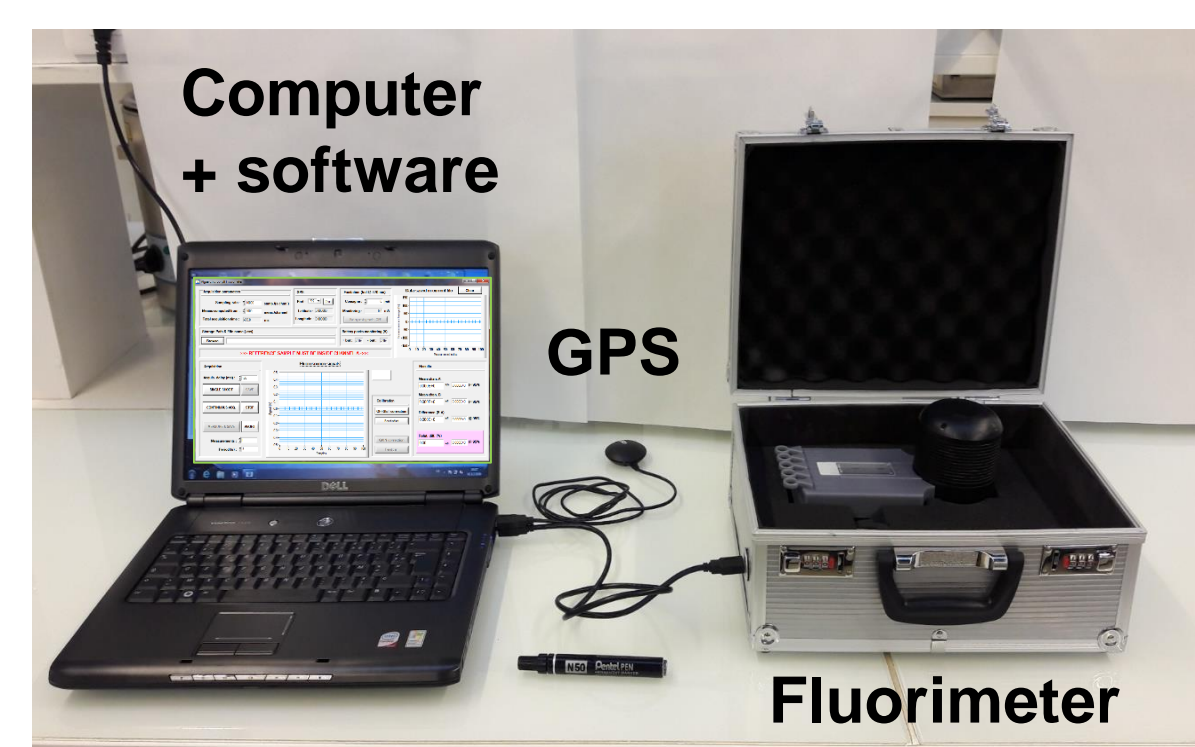
1

Device construction



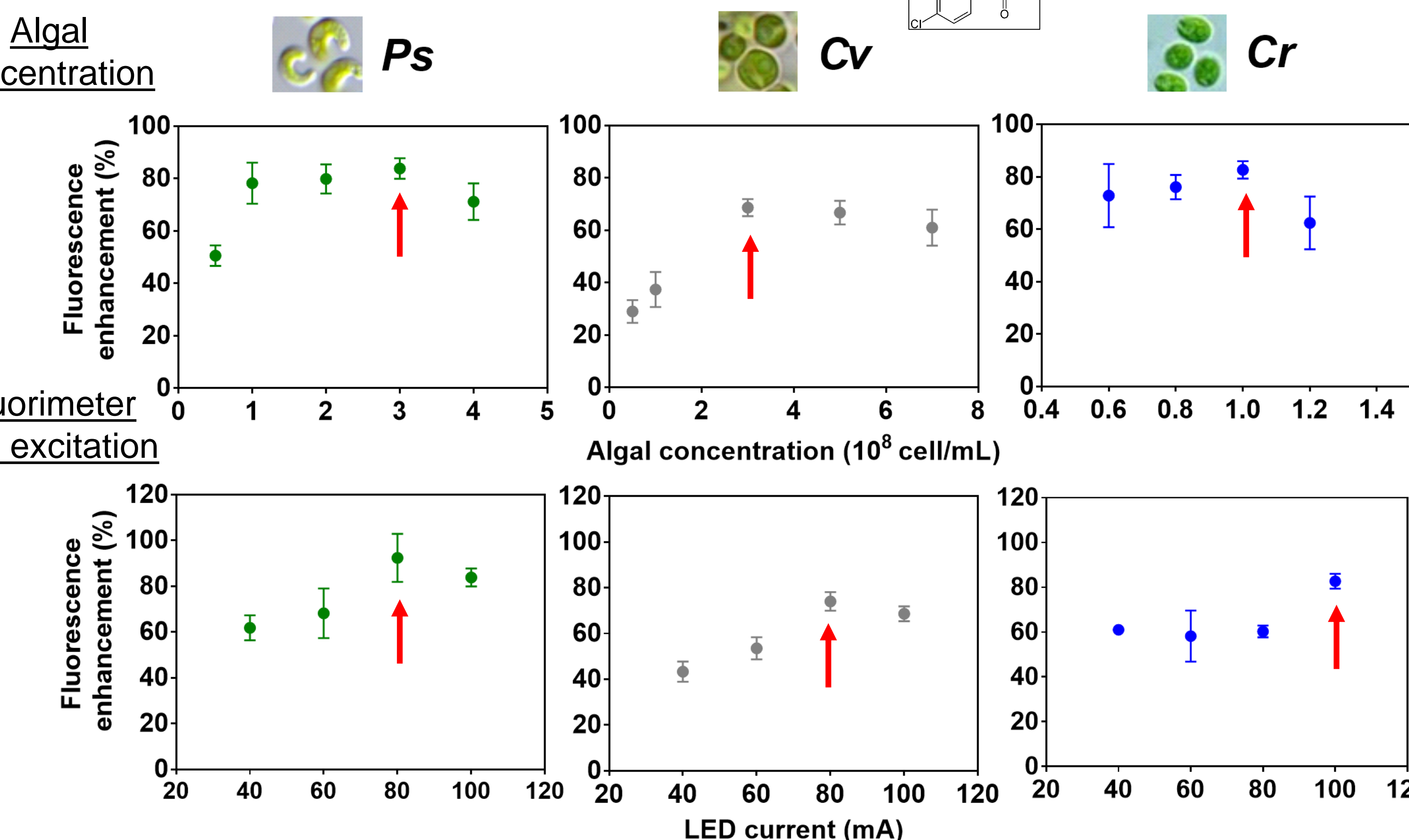
Xurography machine for microfluidic channels, fabricated in DSPA (double-sided pressure adhesive)

Fluorimeter device dedicated to microfluidic chip analysis



2

Sensor sensitivity parameter optimization using a model pesticide (Diuron)



Optimization of these parameters with an exposure time of the algae to the Diuron of 20 (Ps), 5 (Cv) and 10 (Cr) minutes respectively. Application of the sensor (3 and 4) with the same conditions.

Conclusion

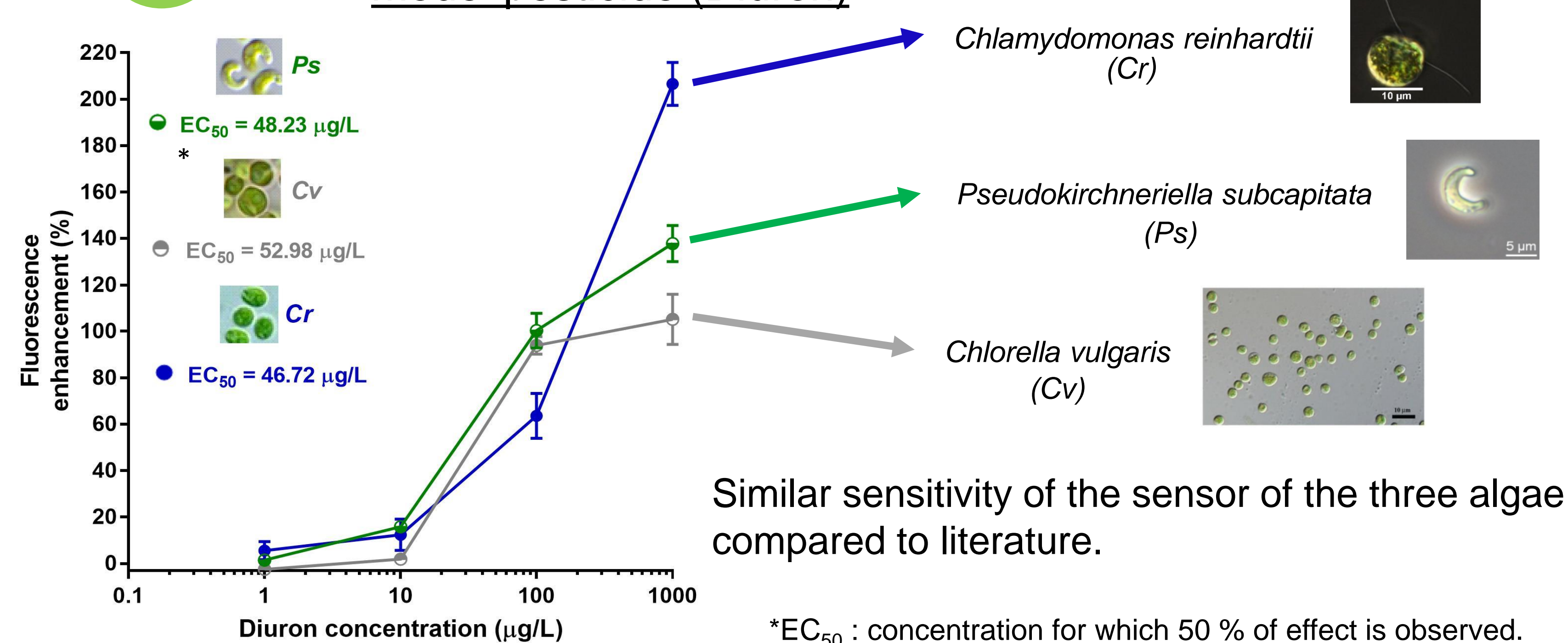
- We developed here a ready-to-use water toxic pollution biosensor :
 - Low cost
 - Fast and easy to construct
 - Reliable
 - Portable
 - Easy-to-use
 - Sensitive
 - Fast to respond
- The potential of microfluidic and xurography for algal sensor construction was demonstrated.
- The use of multiple algae strains is essential to develop an effective tool.

Further Work

- To develop a multi-channel (for replicates) sensor using more complex chips.
- To avoid preliminary algal concentration using lab-on-a-disc technology.
- To calibrate the sensor with many different kinds of waters/discharges.

3

Sensor sensitivity evaluation using a model pesticide (Diuron)



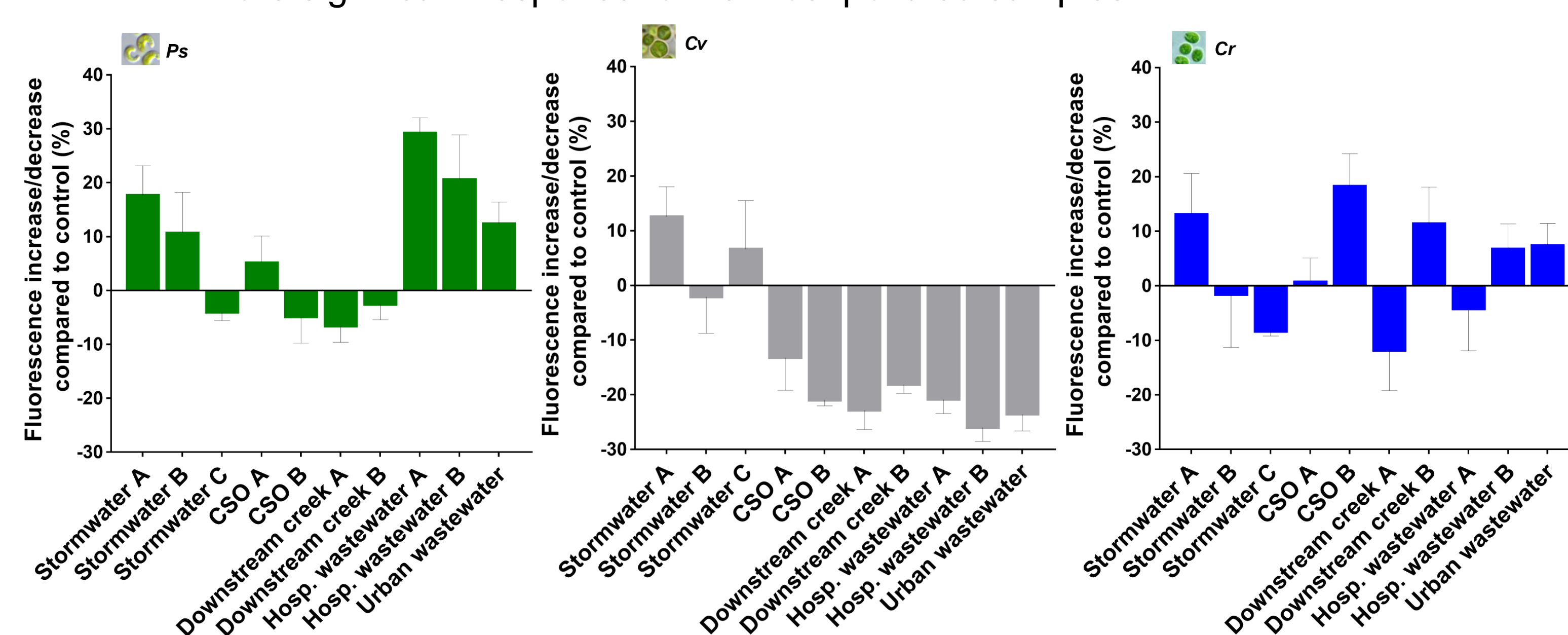
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Application of the biosensor to urban discharges toxicity evaluation

Application to 10 urban discharges toxicity evaluation : 3 stormwaters, 2 combined sewer overflows (CSO), 2 contaminated suburban creeks, 2 hospital and 1 urban wastewater treatment plant influents.

Main observations :

- A different response of the three algae to the 10 samples tested.
 - Potential for using multiple algae strains
- A more significant response to the most polluted samples.



References

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