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Title:

Microalgae lab-on-chip microbiosensor for environmental monitoring

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**Abstract:** (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

The present work aims at developing a microbiosensor for water toxicity analysis. It consists in fabricating a portable system for real-time detection that provides an early indication by sorting the samples needed to be further analyzed by conventional techniques. The lab-on-chip platform offers the possibility of conducting double complementary detection: optical and electrochemical. Disturbances in metabolic activities of algae, the biological sensing element inserted to the solution to be evaluated, are generated by the presence of pesticide (Diuron). These modifications are monitored by measuring simultaneously variations in fluorescence emitted by algae as well as current variations reflecting the biochemical phenomena taking place (photosynthetic O<sub>2</sub> production and H<sub>2</sub>O<sub>2</sub>/OH<sup>-</sup> concentration variations at intracellular level).

The lab-on-chip structure is fabricated on a high optical transmission glass substrate. The integrated three-electrode electrochemical microsensor is developed by PVD process (Ti/Pt layers for working and counter electrodes, Ti/Pt/Ag layers for reference electrode later oxidized in Ag/AgCl) followed by electrodeposition of Black Platinum (Bl Pt) or IrOx in order to functionalise working electrodes. Si<sub>3</sub>N<sub>4</sub> layer deposited by ICP-CVD process is used as long-term passivation. Microfluidic chambers and channels are structured by patterning SU8 photoresist whereas a glass cover is stuck on the structure using the wafer bonder to seal microfluidic tanks (Fig 1 and 2).

Microbiosensors, integrated on the microfluidic lab-on-chip structure, demonstrate highly sensitive Nernstian responses for pH measurements with no hysteresis (59mV/pH for the IrOx electrode - Fig 3). A LOD of 50nM is obtained for H<sub>2</sub>O<sub>2</sub> with Bl Pt electrode (Fig 4). Bl Pt electrodes are then used to monitor microalgae photosynthetic activity (i.e. O<sub>2</sub> production) in the presence and absence of pesticide (Fig 5). Even if algal respiration (light off) is not disturbed, photosynthesis (light on) is partially hindered by pesticide and therefore a variation in oxygen production rate is observed.

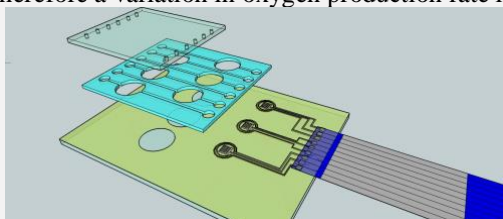


Figure 1: Schematic presentation of fabrication procedure

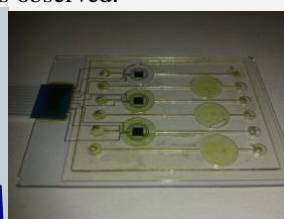


Figure 2: Lab-on-chip biosensor platform

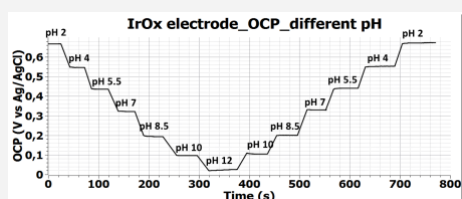


Figure 3: pH monitoring with OCP measurement

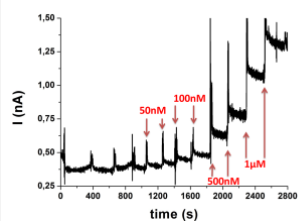


Figure 4: H<sub>2</sub>O<sub>2</sub> detection with Bl Pt array electrode

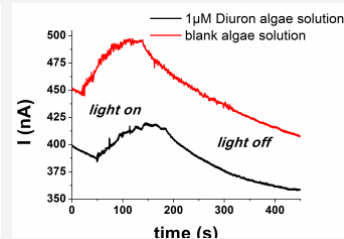


Figure 5: Algal response to Diuron pollutant