

Microalgae electrochemical microbiosensor for water toxicity analysis

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The goal of our research lies in developing a three-electrode electrochemical microbiosensor integrated on a lab on chip platform used in environmental applications and more specifically water toxicity analysis. It consists in fabricating a portable system for on-site detection of herbicides in water. The detection is performed by measuring the disturbances in photosynthetic and metabolic activities of algae caused by traces of herbicides. The system offers the possibility of conducting double complementary detection, electrochemical and optical, by measuring current variations reflecting the biochemical phenomena and fluorescence emitted by algae respectively. The electrochemical system enables a real-time parallel monitoring of multiple electro-active species taking part in metabolic activities of algae and more particularly O_2 , H_2O_2 and OH^- pH-related ions. Electrodes and fluidic part including measurement chambers and channels were integrated on glass substrate in order to obtain a system compatible with optical technologies (Fig. 1). Platinum and platinum black (BI Pt) working microelectrodes were fabricated for H_2O_2 and dissolved O_2 whereas W/WO_3 and IrO_x microelectrodes were used for pH monitoring. A Pt counter microelectrode and an Ag/AgCl reference microelectrode were then integrated in the structure. Electrodes exhibited high sensitivity for H_2O_2 detection and low detection limits (50nM). pH electrodes demonstrated a linear Nernstian response over a wide pH range (59 mV/pH). The performances of the Pt and BI Pt sensors for O_2 detection were evaluated and compared by recording the oxygen reduction current during algae photosynthesis and respiration. Variations in photosynthetic activity of algae were determined in presence of different concentrations of Diuron herbicide by comparing oxygen production rates (Fig. 2).



Fig.1: Lab-on-chip electrochemical biosensor

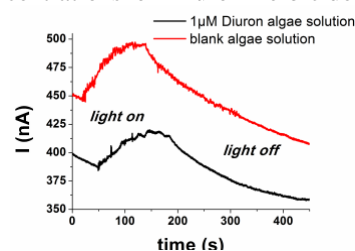


Fig. 2 : Algal response to pollutant