Self-Powered Herbicide Biosensor Utilizing Thylakoid Membranes

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A self-powered biosensor has been developed for the detection of herbicides in water. This biosensor makes use of a bioanode incorporating thylakoid membranes bioanode for direct photoelectrocatalysis with an air-breathing platinum cathode. Herbicides inhibit the thylakoid activity, leading to a decrease in current output via inhibition of the photosynthetic pathway, which is the natural mechanism of function of herbicides and the mechanism of photoelectrocatalysis in the bio-solar cell. This current decrease can be used to determine herbicide concentrations. This sensor was able to detect several commercial herbicides (atrazine, bromacil, and diuron) with a linear response up to concentrations of ~15 µg/L and limits of detection (LOD) below 0.5 µg/L as seen in Figure 1. This herbicide biosensor is capable of detecting the presence of a variety of herbicides at sensitivities similar to current detection techniques. This biosensor does not require large instrumentation which allows for its easy use in the field and requires no sample preparation to concentrate the desired compounds. However, this biosensor is non-specific and requires the presence of light to operate.

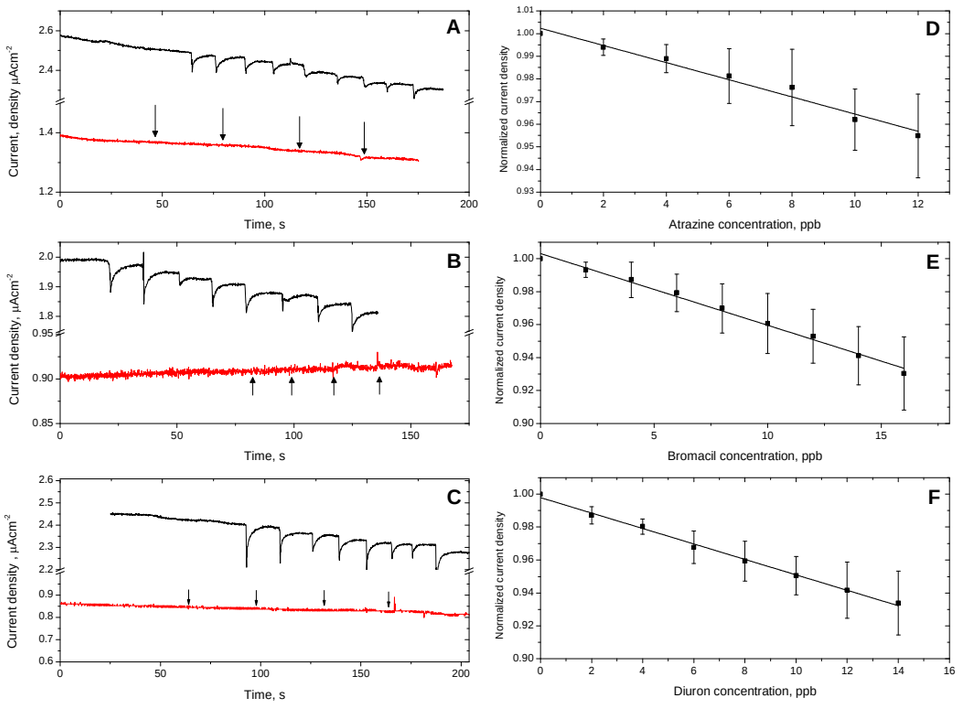

Fig. 1. Amperometric data obtained with a thylakoid bio-solar cell in 0.1 M phosphate buffer, pH 7.4, with additions of herbicide. Also shown are calibration curves generated from the measured currents. Data collected in the light (black lines) and dark (gray lines) is shown for three herbicides. For the data collected in the dark, arrows indicate the times herbicide was added: (A) atrazine; (B) bromacil; (C) diuron; (D) calibration curve for atrazine; (E) calibration curve for bromacil; (F) calibration curve for diuron. Measured current values were normalized by dividing by the current measured at 0 V in the absence of herbicide.