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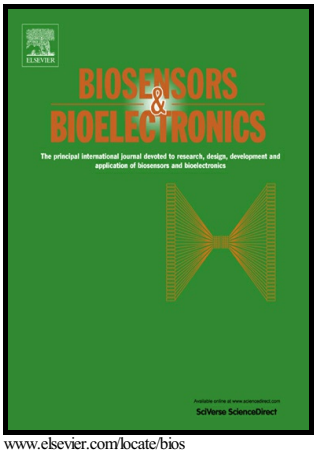

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Microbiosensor for the detection of acetate in electrode-respiring biofilms

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Abstract

The goal of this work was to develop a microbiosensor to measure acetate concentration profiles inside biofilms *in situ*. The working principle of the microbiosensor was based on the correlation between the acetate concentration and the current generated during acetate oxidation by *Geobacter sulfurreducens*. The microbiosensor consisted of a 30-μm carbon microelectrode with an open tip as a working electrode, with *G. sulfurreducens* biofilm on the tip and a pseudo Ag/AgCl reference electrode, all enclosed in a glass outer case with a 30-μm tip diameter. The microbiosensor showed a linear response in the 0-1.6 mM acetate concentration range with a 79 ± 8 μM limit of detection (S/N=2). We quantified the stirring effect and found it negligible. However, the interfering effect of alternative electron donors (lactate, formate, pyruvate, or hydrogen) was found to be significant. The usefulness of the acetate microbiosensor was demonstrated by measuring acetate concentration depth profiles within a *G. sulfurreducens* biofilm. The acetate concentration remained at bulk values throughout the biofilm when no current was passed, but it decreased from the bulk values to below the detection limit within 200 μm when current was allowed to pass. The zero acetate concentration at the bottom of the biofilm showed that the biofilm was acetate-limited.

Keywords: Microbiosensor; acetate; biofilm; *Geobacter*; electron transfer; microelectrode