Non-Invasive Characterization of Real Time Biofilm Analyte Flux

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The development of sensors with real time temporal resolution and sub-micromolar detection limits are vital to design of bioprocessors in the field of environmental engineering. In addition to ongoing research aimed at developing new and enhanced sensors (e.g., increased sensitivity, enhanced analyte selectivity, reduced response time, and novel microfabrication approaches), work over the last few decades has also advanced sensor utility through new sensing modalities that extend and enhance the data recorded by the sensor. One approach that has revolutionized cell biophysical transport studies is the self-referencing microsensor technique, which has proven to be extremely valuable in neurobiology, plant physiology, and developmental biology applications. Self-referencing converts static concentration sensors into dynamic analyte flux sensors for real time, non-invasive characterization of active biological transport. The self-referencing sensor technique will be demonstrated for real time characterization of analyte flux in environmental biofilms. User friendly equations have been developed which account for the effects of interactions with compounds within the bulk liquid (e.g., buffers/chelators). A reversible enzyme inhibition study on a *Nitrosomonas europaea* biofilm will be presented, demonstrating enhanced measurement resolution by phase discrimination that subtracts out background drift and signal noise associated with concentration mode sensors. Real time monitoring of aerobic respiration in biofilms following exposure to uncoupling agents will also be presented. Use of self-referencing flux measurements for quantifying biofilm physiology advance our understanding of fundamental phenomena concerning bioprocessor design, chemical toxicity exposure, biodegradation of hazardous compounds, and biocorrosion.