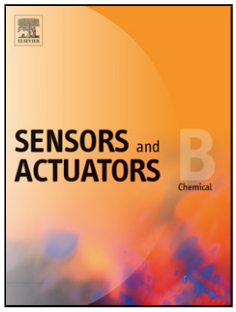

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On-Chip Microelectrode Array and In-Situ Transient Calibration for Measurement of Transient Concentration Gradients Near Surfaces of 2D Cell Cultures

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Abstract

Amperometric microelectrode arrays (MEAs) interrogate the concentration at multiple positions simultaneously and with sufficient sampling rates, thus being able to capture fast transient gradients. However, sensitivity variability issues in amperometric MEAs degrade the reliability of the measurements, particularly at the small concentration scales found in physiological studies. This paper describes the development of on-chip platinum amperometric MEAs and in-situ transient calibration for reliable measurement of physiological transient concentration gradients. The designed MEA geometry facilitates positioning near a 2D cell culture setup, and the proposed in-situ transient calibration minimizes the effects of sensitivity variability, thus allowing for calculation of gradients based on concentration differences between closely spaced electrodes. The effectiveness of the MEA and the in-situ transient calibration was evaluated by measuring controllably-generated gradients, and then calculating the difference between experimental and simulated data using normalized time analysis. Gradients generated by periodic uptake intervals as fast as 150 ms followed by recovery intervals of 60 s were measured over a spatial range of 70 μm, with spatial resolution of 35 μm, and

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