Integration of miniature, ultrasensitive chemical sensors in microfluidic devices

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Simple construction, good detection limit[1], very low power demand, and simple experimental setup coupled with miniaturization opportunities arising from solid-state format makes ISEs an excellent prospect for integration in autonomous sensing devices and ultimately their integration in large wireless chemo-sensing networks.[2,3] Microfluidics, also known as “lab-on-a-chip” is an emerging technology that is changing the future of instrument design. Microfluidics enables small scale fluid control and analysis, allowing developing smaller, more cost-effective, and more powerful systems.[4,5,6]

We are working on development of miniature devices featuring sensitive yet simple sensors that could enable rapid access to important environmental information from *in-situ* deployed sensors, and thereby facilitate timely action to minimize the adverse impact of emerging incidents. Our work involves integration of ultra-sensitive yet simple chemical sensors into a microfluidic device that has integrated wireless communications capabilities. Our ultimate objective is to develop a microfluidic chip that will incorporate polymer-based lead-selective solid-state electrodes. We will test the series of developed chips for the best design to accommodate these sensors. Initially, we are targeting lead-selective sensors and their application to the monitoring of drinking and natural water quality.

Our ultimate vision is the development of a microfluidic-based platform with fully integrated screen-printed solid-state ISEs, and the associated reference electrode, which will be suitable for use as a chemo-sensing component in a widely distributed wireless sensor network (WSN) for monitoring the quality of a fresh water system. A key challenge in the realization of this vision is to build in advanced system diagnostics, and particular, sensor status tests using simple electronic signals, in a manner similar to those used in physical transducers.[7] In this way, it may be possible to assist in distinguishing sensor malfunction or signal artifacts from real events, even in relatively simple, low cost platforms.

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