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Microfluidic Polymer Chip with an Embedded Ion-Selective Electrode Detector for Nitrate-Ion Assay in Environmental Samples

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A nitrate ion-selective electrode (NO₃⁻-ISE) has been developed based on tetradodecylammonium bromide as an anion exchanger and 2-nitrophenyl octyl ether as a plasticizer. The NO₃⁻-ISE shows an almost Nernstian response to nitrate ion over a concentration range between 1.0 × 10⁻⁶ and 1.0 × 10⁻¹ M, with an anionic slope of -57.7 ± 0.7 mV/decade. The selectivity coefficients of the NO₃⁻-ISE for nitrate ion against chloride and sulfate (log $k^{\text{Pot}}_{\text{NO}_3^-, \text{Cl}^-} = -2.42$ and log $k^{\text{Pot}}_{\text{NO}_3^-, \text{SO}_4^{2-}} = -4.33$) were obtained. A microfluidic polymer chip was fabricated using polystyrene plates and stainless-steel wires as a template for the channel. The microfluidic polymer chip is composed of a mixing chip and a NO₃⁻-ISE detector chip. The microfluidic polymer chip, integrated with a NO₃⁻-ISE detector consisting of the NO₃⁻-ISE and a Na⁺-ISE as a reference electrode, showed an almost Nernstian response to nitrate ion over a concentration range between 1.0 × 10⁻⁵ and 1.0 × 10⁻¹ M, with an anionic slope of -54.3 ± 1.3 mV/decade. The

microfluidic polymer chip was then applied to the determination of nitrate ion in environmental water samples, such as a tap water, a well-water sample and water for agricultural use.

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