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23rd & 24th August 2024

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PR17

MICROCHIP ASSISTED MICROFLUFIC METHOD FOR *IN SITU* TOTAL NITROGEN DETECTION IN WATER

Z. Wu[1,2,3], S.P. Hemachandra[1,2*], X. Chen[1,2,4] and R. Weerasooriya[1,4]

[1]*Centre for Water Quality Research, National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*China-Sri Lanka Joint Research and Demonstration Centre for Water Technology, Peradeniya, Sri Lanka*
[3]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka*
[4]*Institute of Industry and Equipment Technology, Hefei University of Technology, Hefei, PR China*

The flourishing field of microfluidic technology offers unparalleled prospects for environmental monitoring by enabling rapid, multi-parameter analyses with minimal sample requirements. This expedites the detection process and aligns with UN sustainable development goals by reducing the pollution footprint of analytical practices. Several surface modification techniques are carried out to minimize non-specific adsorption and enhance the compatibility of microfluidic chips with different samples. However, system consistency and detection sensitivity remain key hurdles for the widespread adoption of these techniques. One of the key goals of the study was to explore the design of a special extended-path length optical system to achieve lower detection limits. This research explores the above critical issues, focusing on the impact of cutting fluid in the fabrication of polymethylmethacrylate (PMMA) microchips on the detection of total nitrogen. To address the outlined research questions, a comprehensive screening test was conducted to determine the known concentration of total nitrogen in a water sample using fabricated microchips comprised of four distinct pressure-sensitive films and a double-sided adhesive, aiming to assess the adherence properties. The microfluidic chip constructed utilizing pressure-sensitive film with double-sided adhesive demonstrated a higher level of efficiency. The effect of different commercially available pressure-sensitive films on the surface of the chips was also evaluated, specifically targeting their role in modulating the absorption characteristics at the wavelength of 220 nm associated with total nitrogen detection. The pre-cut pressure-sensitive films exhibited excellent performance when applied to the surfaces of the chips for the determination of the total nitrogen of the water sample. Additionally, multiple analytical techniques were deployed to assess the consistency and sensitivity of the microfluidic system under different conditions. The efficiency of cutting fluids in the detection of total nitrogen was investigated using certified samples with concentrations ranging from 1 mg L^{-1} to 5 mg L^{-1}. Initially, without the cutting fluid, the relative errors for the measurements continued to rise at 50%. However, after introducing the cutting fluid, a remarkable decrease in relative error to 0%, 0%, 5%, 7% and 1% were observed for concentrations of 1 mg L^{-1}, 2 mg L^{-1}, 3 mg L^{-1}, 4 mg L^{-1} and 5 mg L^{-1}, respectively. This result underlines the significant positive effect of cutting fluid in lubricating the microfluidic chip during fabrication, consequently enhancing the accuracy of the detection process. By unraveling the role of cutting fluid in the fabrication of PMMA detection chips, the understanding of system consistency and detection limit issues in microfluidic applications for environmental analysis has been advanced in this study.

Keywords: Cutting fluid, Lab-on-a-chip, Microfluidic technology, Micro-sensors, Nitrogen detection

[*]*samadhi.he@nifs.ac.lk*