

Photonic system for continuous monitoring of eutrophic contaminants in aquatic environments

Krzysztof Anders^{1,2,3,#}, Anna Jusza^{1,3}, Jerzy Kalwas^{1,3}, Paweł Bortnowski¹, Michał Kozubal¹, Aleksandra Bieniek-Kaczorek¹, Agata Daniszewska¹, Łukasz Kozłowski¹, Stanisław Stopiński^{1,2,3}, Edyta Kiedrzyńska⁴, Ryszard Piramidowicz^{1,2,3}

¹Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Koszykowa 75, 00-662 Warsaw, Poland

²VIGO Photonics S.A., Poznańska 129/133, 05-850 Ożarów Mazowiecki, Poland

³LightHouse Sp. z o.o., Stefczyka 34, 20-151 Lublin, Poland

⁴European Regional Centre for Ecohydrology of the Polish Academy of Sciences, Tylna 3, 90-364 Łódź, Poland

This work presents the development and validation of an advanced optical method for identifying and quantifying water contaminants responsible for eutrophication. The research is focused on the application of UV–VIS–MIR absorption spectroscopy for the precise detection of trace concentrations of nitrogen compounds, specifically nitrite (NO²) and nitrate (NO³-) ions. To translate the spectroscopic concept into a practical sensing solution, compact and energy-efficient, the method was implemented in a functional photonic system demonstrator.

The device integrates a cuvette measurement chamber, a miniaturized UV light source, and a highly sensitive photodetector, enabling direct spectral measurements without the need for complex chemical reagents or sample preparation procedures.

The developed demonstrator represents an important step towards the miniaturization and commercialization of autonomous water-monitoring systems. By enabling continuous, real-time assessment of water quality, the proposed technology offers a promising, sustainable solution for environmental monitoring and early detection of eutrophication.

The presented approach also demonstrates the potential of photonic technologies to enable compact, low-cost, and reagent-free environmental sensing systems for future distributed monitoring networks.

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corresponding author: krzysztof.anders@pw.edu.pl