Nanofiber-Based Analytical Device (nFAD) as a Novel Alternative to Paper-Based Sensors for Fluoride Detection

Aldona Jelińska[1], Justyna Kalisz[1], Fabrizio Caroleo[2], Ewa Jaworska[1], Emilia Stelmach[1], Corrado Di Natale[1], Krzysztof Maksymiuk[1], Roberto Paolesse[2], Agata Michalska[1,†]

[1]Faculty of Chemistry, University of Warsaw, Pasteura 1, Warsaw 02-093, Poland
[2]Dipartimento di Scienze e Tecnologie Chimiche, Università di Roma Tor Vergata, Via della Ricerca Scientifica 1, Roma 00133, Italy
† corresponding author's email: agatam@chem.uw.edu.pl

An innovative alternative to traditional paper-based analytical devices is presented. This nanofiber-based analytical device (nFAD) features a porous structure and is fabricated from a plasticized, lipophilic polymer incorporating a fluoride-selective corrole ionophore and an ion-exchanger. This material functions as a sensing layer enabling camera-assisted optical detection of fluoride ion concentration changes in a sample, mediated by the Si-corrole ionophore. The device exhibits a linear correlation between the color intensity (in the red or green channel) and the logarithm of the analyte concentration over the range from 10^{-6} to 10^{-1} M. Notably, the analytical response is obtained rapidly and no pH buffer is required in the sample.

The device offers rapid response, operating without pH adjustment due to its optimized hydrophobic environment. The nanofiber structure ensures mechanical flexibility, durability, and chemical resistance. This study demonstrates the feasibility of nFAD as a robust, optically readable sensor for environmental, healthcare, and food safety applications, combining the structural advantages of nanomaterials with the specificity of synthetic ionophores

Acknowledgments

The authors gratefully acknowledge financial support from the National Science Centre, Poland, through project OPUS 21: "Optical emission insight into processes occurring in the ion-selective sensors operating under electrochemical trigger – towards ion-selective spectrofluoroelectrochemistry", grant no. UMO-2021/41/B/ST4/03401. Your acknowledgment text goes here.

References

[1] J. Kalisz, A. Jelińska, F. Caroleo, E. Jaworska, E. Stelmach, C. Di Natale, K. Maksymiuk, R. Paolesse, A. Michalska, *Sensors and Actuators B: Chemical*, **441**, 137945 (2025).
[2] A. Jelińska, J. Kalisz, D. Pociecha, K. Maksymiuk, A. Michalska, *Electroanalysis*, **36**, e202300287 (2023).