Impedimetric Sensing of PFOA in Drinking Water

Qamar Hayat Khan,[1] **Ramachandra Legundapati,**[2] **Gyu Leem,**[2] **and Benjamin D. Sherman**[1],

[1]Department of Chemistry & Biochemistry, TCU, TX 76129, [2] Department of Chemistry & Biochemistry, TCU, TX 76129; 2 Department of Chemistry, SUNY, Syracuse, New York 13210, United States

Abstract

Per- and polyfluoroalkyl substances (PFAS) are persistentenvironmental contaminants that pose significant risks to human health and ecosystems.[1] This poster is focused on the development of a label-free impedimetric sensor[2] for the detection of PFAS in aqueous systems. The sensing platform is based on fluorine-doped tin oxide (FTO) electrodes functionalized with perfluorinated self-assembled monolayers (SAMs) to promote fluorophilic interactions with target PFAS molecules, particularly perfluorooctanoic acid (PFOA).

FTO electrodes were modified using trichloro(1H,1H,2H,2H-perfluorooctyl) silane (TCPFOS) to form hydrophobic surface coatings. Successful formation of the SAM layer was confirmed through water contact drop experiment. Surface coverage of the monolayer was evaluated using cyclic voltammetry (CV) with the ferri/ferrocyanide redox couple, where cathodic peak current reduction indicates effective surface blocking by the SAM layer.

Impedance measurements were subsequently performed in 0.1 M NaCl electrolyte at controlled pH (4.5) while exposing the functionalized electrodes to varying concentrations of PFOA. The impedance data were qualitatively by plotting Cole–Cole capacitance plots to evaluate changes in effective interfacial capacitance and quantitatively by circuit fitting.[3] These capacitance variations were correlated with PFAS concentration to assess sensor sensitivity and response behavior.

The results demonstrate that the TCPFOS-modified FTO surfaces produce measurable and reproducible capacitance changes in response to PFOA exposure, indicating the potential of fluorophilic surface chemistry combined with impedance spectroscopy for PFAS detection. This work contributes toward the development of a simple, label-free electrochemical sensing platform for monitoring PFAS contamination in water.

References

(1) Evich, M. G.; Davis, M. J.; McCord, J. P.; Acrey, B.; Awkerman, J. A.; Knappe, D. R.; Lindstrom, A. B.; Speth, T. F.; Tebes-Stevens, C.; Strynar, M. J. Per-and polyfluoroalkyl substances in the environment. *Science* **2022**, *375* (6580), eabg9065.
(2) Zhang, M.; Zhao, Y.; Bui, B.; Tang, L.; Xue, J.; Chen, M.; Chen, W. The latest sensor detection methods for per-and polyfluoroalkyl substances. *Crit. Rev. Anal. Chem.* **2025**, *55* (3), 542–558.

(3) Gabriunaite, I.; Valiūnienė, A.; Sabirovas, T.; Valincius, G. Mixed Silane-based Self-assembled Monolayers Deposited on Fluorine Doped Tin Oxide as Model System for Development of Biosensors for Toxin Detection. *Electroanalysis* **2021**, *33* (5), 1315–1324.