Intensity based POF sensors for water quality assessment

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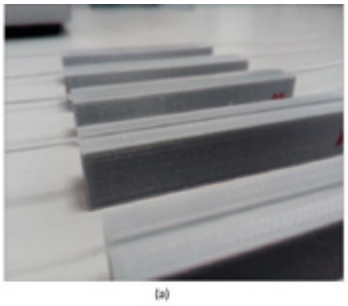
Low-cost and user-friendly solutions for water quality assessment are needful nowadays, which can allow for remote, in-site and real-time monitoring of water contaminants. Sensing technologies using Polymeric Optical Fibres (POFs) combined with specially developed sensitive layers for chemical detection may offer these possibilities, with proper interrogation systems.

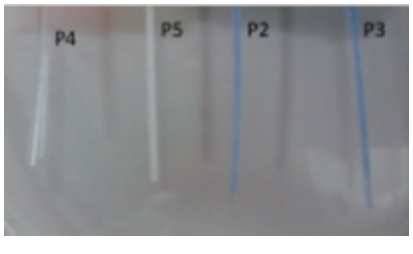
POF sensing platforms based on low-cost procedures were developed and characterized using aqueous solutions of different refractive indices (RI). The POF RI sensors were optimized by varying the length and/or roughness of the sensing region and resolutions of 10-4 RIU were obtained. A portable optical setup was used, which allows real time monitoring through Bluetooth technology, enabling in-site and remote monitoring. The intensity based detection system incorporated a reference POF allowing for a self-referenced signal, avoiding small source fluctuations. The stability of the transmitted signal was verified, as well as the reproducibility on the sensor's responses and signal recovery with washing procedures with distilled water.

The suitability of these sensing platforms for chemical detection was evaluated through the coating with sensitive layers, namely Molecularly Imprinted Polymers (MIPs) using different deposition techniques. A D-shaped POF chemical sensor was successfully developed using a sensitive MIP layer, allowing the detection of perfluorooctanoate (POFA/PFO-) in aqueous media with a limit of detection of 0.20 – 0.28 ppb.

The dependency of proteins immobilization on the POF's sensing region was evaluated for straight POF's configuration, aiming future developments in chemical detection using POF biosensors. The protein's immobilization was confirmed using a binding-specific dye.
Obtained results show a promising future for the development of low-cost POF chemical sensors and biosensors, as different layers can be coated on POF's surface allowing for the detection of different analytes/contaminants.

FIGURE 1
Sensing platforms: (a) photograph of D-shape POFs; (b) schematic representation of a D-shape POF-MIP covered with water. [1]





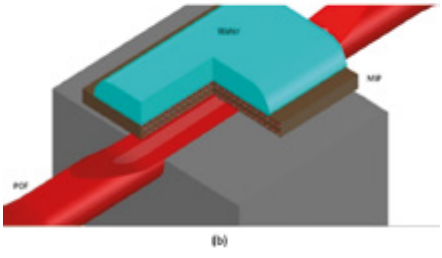


FIGURE 2
Protein immobilization on POF's surface is easily seen at naked using a binding-specific dye. [2]

[1] N. Cennamo *et al.*, "A simple and low-cost optical fiber intensity-based configuration for perfluorinated compounds in water solution," *Sensors (Switzerland)*, vol. 18, no. 9, 2018.
[2] F. Sequeira, R. Nogueira, L. Bilro, and T. Santos-Silva, "Coating of modified plastic optical fibers with proteins for chemical sensing and biosensing: preliminary studies," in *Proc. SPIE 11028, Optical Sensors 2019*, 2019, no. 110282O.