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PDMS COATED UV SENSOR FOR CONTINUOUS MONITORING OF BTEX IN GROUNDWATER

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Benzene, toluene, ethylbenzene, and xylenes (BTEX) are toxic compounds. Analytical methods such as GC-FID are currently used to quantify BTEX in groundwater [1]. Although very sensitive, these methods are expensive, time-consuming, and involve a periodical sampling. Optical fiber sensors based on evanescent wave absorption spectroscopy could be an *in-situ* efficient low-cost alternative.

Optical fibers are made of three layers: (1) a protective layer, (2) a fluorine-doped silica cladding, and (3) a pure silica core. Light is transmitted in the core along the optical fiber by total internal reflection. However, at the cladding-core interface, evanescent waves propagate in the normal direction and decrease exponentially with the distance beyond the core surface [2]. By removing the cladding, evanescent waves can interact with the surrounding medium. If a cladding-free optical fiber is immersed in a medium which contains analytes that absorb light, a decrease of the signal transmitted along the fiber may be detected.

The aim of the present work is to develop an optical fiber sensor based on evanescent wave spectroscopy absorption in the UV wavelengths to measure BTEX in groundwater in real-time. The desired sensitivity is less than 1 ppm. To reach this goal, a polydimethylsiloxane (PDMS) layer is synthesized by sol-gel and deposited on the core surface of the cladding-free optical fibers by a dip-coating process. PDMS has a great affinity with BTEX which are adsorbed on its surface [3] and, thus, concentrated near the core surface. This results in a sensitivity enhancement of the sensor.

Last experiments show promising results as a signal loss was detected for a solution of 1 ppm of ethylbenzene. A first calibration curve has been drafted from 1 to 16 ppm. The literature reports that the addition of phenyl groups in PDMS during the sol-gel synthesis could enhance its affinity with BTEX by π- π^* interactions. Experiments to corroborate these studies are still in progress [4].

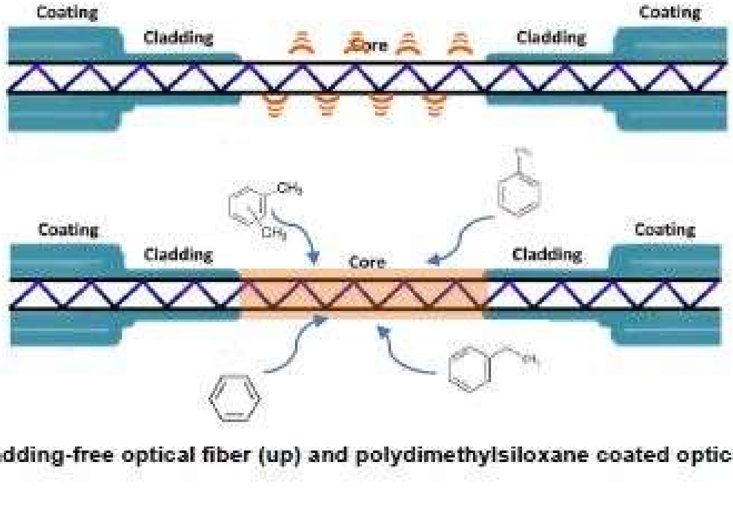

Figure 1: Cladding-free optical fiber (up) and polydimethylsiloxane coated optical fiber (down).

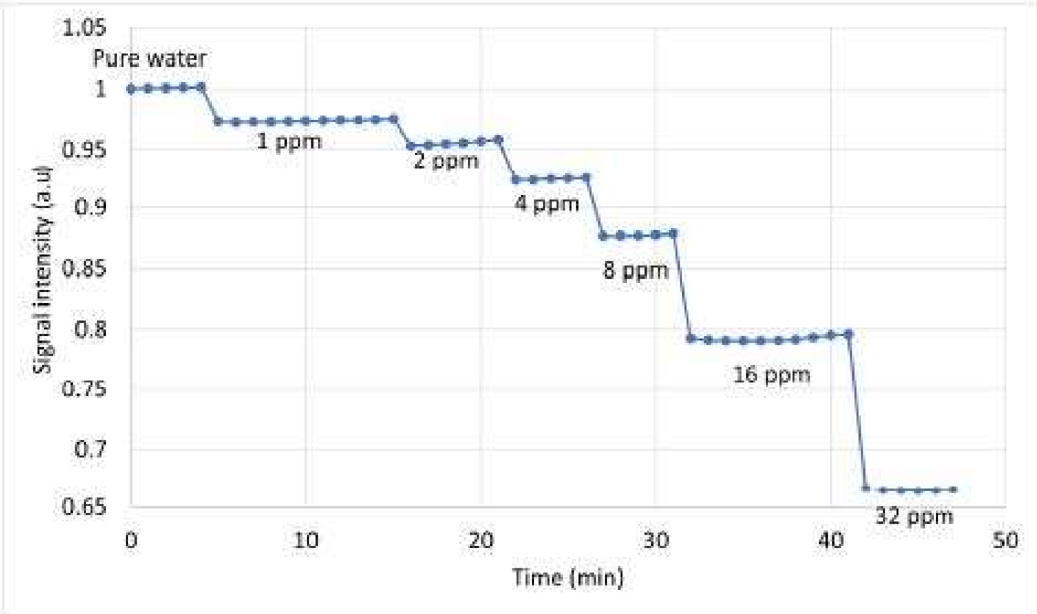

Figure 2: Succesive additions of ethylbenzene in water. Each drop of the signal occurs when the pollutant is injected. The concentration of ethylbenzene in the cell test after each injection is given in the graph (bellow each plateau).

References

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