Porous Silicon based optical detector of impurities in water (Ramot)
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Motivation

The area of chemical sensors is one of the fastest growing both in research and in commercial fields. Most of the research work in this area is concentrated towards reducing the size of sensors and the identification and quantification of multiple species. Quick response, minimum hardware requirement, good reversibility, sensitivity, and selectivity are expected from an excellent sensor, and hence there is a need for further research. The applications of chemical sensors include quality and process control, biomedical analysis, medical diagnostics, environmental pollution control, continuous and long term monitoring of pollutants and hazardous substances. There are however several outstanding problems
hindering aplications of chemical sensors based on optical readout. It is widely accepted that in many instances the sensitivity is not the limitation of the sensor. Indeed many sensors display oversensitivity at the expense of specificity and are vulnerable to noise. In real applications the environment in which sensors are located is not sterile: additional substances present will cause spurious readouts, and moreover, the substances may react over the sensor's surface and readouts will be then cross-correlated.

There is an apparent need for methods and devices able to detect and identify specific pollutants in water in real time, with an high degree of sensitivity and reliability. Most common methods require sampling the water, analyzing in specially dedicated kits or eventually needing further transfer to a specialized laboratory. This last requirement is specially relevant when the pollutants appear in minute concentrations, as many poisonous substances have a cumulative effect in human organisms, among other heavy metals and steroids. Our previous experience in manufacturing and operating gas sensors for simultaneous reading and analyzing arrays of units in gaseous environments [1] motivate us to attempt similar approaches and techniques for multi-sensing in water and other liquid media. According to our last experiments, up to four different hydrocarbons were simultaneously detected and identified in nitrogen by means of a single device and the optical readout comprised a single beam of light. To our best knowledge there is no device or setup with similar capabilities in liquid media.

Main characteristics of the proposed technology.

Our immediate aim is to adapt the multi sensing technique developed in our laboratory, based on porous silicon films, to the demanding conditions of aqueous environments. As such, the detectors to be developed would enjoy the following features:

1. Similarly to their gaseous counterparts, the water sensing units would be entirely passive, meaning that they need no contact to current, batteries or other forms of power supply.
2. Low cost of sensing units and entire system, whereas a single optical source and analyzing unit can monitor tens and eventually hundreds of sensing chips
3. Remote monitoring due to separation between the optical readout unit and the sensing units
4. Simultaneous sensing of several substances [1].
5. Enhanced reliability [2].
6. Compact size

[1] S. Ruschin and T. Hutter US Patent 9013707, 2015
[2] T. Hutter, M Horesh and S. Ruschin "Method for increasing reliability in gas detection based on indicator gradient in a sensor array" Sensors and Actuators B: Chemical 152 (1) 29-36 (2011),

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