

# Optical Fiber-Mounted Porous Silicon Photonic Crystals for Remote Sensing of Environmental Toxins and Volatile Organic Compounds

Tech ID: 19922 / UC Case 2007-299-0

## BACKGROUND

There is a continual need for low cost, small-sized, fast responding sensors for toxic industrial chemicals, volatile organic compounds (VOCs), and chemical warfare agents. In addition, there is a growing need for sensors that can monitor the residual adsorption capacity of activated carbon filtration cartridges in gas masks and personal protective equipment.

In the U.S., government health and safety regulations require the detection of contaminants prior to depletion of the carbon bed's adsorption capacity. However, these regulations have not been yet enacted due to a lack of suitable sensing devices.

## TECHNOLOGY DESCRIPTION

This technology is a method for remote sensing of environmental toxins and volatile organic compounds (VOCs). The novel device developed by UC San Diego could be utilized for environmental sensing and as an end-of-service-life indicator in personal respirators and protection devices.

By coupling previous porous silicon crystal technology with optical fibers, UC San Diego researchers have created a small, pinpoint fiber-optic sensor platform that detects organic vapors through a filter bed of activated carbon. The sensor system, formed by silicon photonic crystals mounted to the tip of optical fibers, is unique in monitoring the wavelength, as opposed to the intensity of transmitted light. The device is therefore less susceptible to conditions affecting the intensity of transmitted light, such as interference from optical loss, changes in the radius of curvature of the fiber, and mechanical vibration.

In addition, the porous silicon surface can be easily chemically modified, allowing the opportunity to influence the response of the sensor towards particular classes of VOCs.

## ADVANTAGES

- Sensing of environmental chemical toxins.
- Opportunity for tailorable surface chemistry and VOC class preference.
- Small fiber-optic based sensor that operates by detecting organic vapors through a filter bed of activated carbon.
- Sensitive to low concentrations of VOCs.
- Detection of VOCs breakthrough of activated carbon filtration beds used in respiratory masks.
- The novel optical fiber-mounted, porous-silicon, photonic crystal senses by monitoring the wavelength, as opposed to the intensity of reflected light.
- In addition to producing a reflectivity spectrum, the porous silicon layer provides a microstructure for concentrating analytes.

## APPLICATIONS

- Environmental sensing, including remote sensing of VOCs, toxic industrial chemicals, and chemical warfare agents.
- Measurement of humidity, vapor phase chemicals, aqueous chemicals, and biomolecules.
- End-of-service-life, or residual service life indicators in personal respirators and collective protection devices.

## STATE OF DEVELOPMENT

## CONTACT

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## OTHER INFORMATION

### KEYWORDS

fiber optic sensor, photonic crystal,  
  
porous silicon, nanomaterials, volatile  
  
organic compounds, VOCs,  
  
environment, toxic industrial chemical,  
  
warfare agents, activated carbon,  
  
protective equipment

### CATEGORIZED AS

- **Sensors & Instrumentation**
  - Environmental Sensors
  - Physical Measurement
  - Scientific/Research

### RELATED CASES

2007-299-0

This technology is offered exclusively or nonexclusively in the U.S. and/or worldwide territories. A commercial sponsor for potential future research is sought.

USER DEFINED 1

- ▶ Michael J. Sailor, Ph.D., is Professor in the Department of Chemistry and Biochemistry at UC San Diego.
- ▶ King B. H., Ruminski A. M., Snyder J. L., Sailor M. J. Optical-Fiber-Mounted Porous Silicon Photonic Crystals for Sensing Organic Vapor Breakthrough in Activated Carbon. *Adv. Mater.* 2007, 19, 4530-4534.
- ▶ <http://chem-faculty.ucsd.edu/sailor/>
- ▶ <http://www-chem.ucsd.edu/research/profile.cfm?cid=C01467>

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,889,954	02/15/2011	2007-299

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