Analytical Instrumentation, Methods & Materials

New Discoveries in Biological Safety: Liquid Crystal Detection of Hazardous Environmental Products

View U.S. Patent No. 9,863,923 in PDF format.

WARF: P150037US02

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a liquid crystal-based method and device for detecting volatile organic compounds.

Overview

Volatile organic compounds (VOCs) are found in common household and industrial products. These toxic and/or carcinogenic compounds such as toluene, benzene and styrene are difficult to detect and persist in environments previously cleared for human entry.

Electrochemical methods remain the gold standard for detecting organic compounds, but VOCs lack the chemically reactive functionalities needed for such methods. While expensive centralized detection and off-site analysis is in use in varying occupational environments, the presence of such hazardous compounds is also not homogenous, necessitating personal detection equipment within a specified area.

Liquid crystal (LC)-based solutions have been proposed as an alternative. However, LC films lack stability while on a solid substrate. Though previous approaches have been developed to remedy this (such as metal grids, polyurethane wells and micropillar arrays), these can be tedious to refill and may make surface chemistry difficult to control. In addition, some LC-based techniques lack sensitivity.

The Invention

UW–Madison researchers have developed a novel LC-based method and device for accurately detecting low concentrations of volatile organic compounds.

When exposed to a VOC or other target analyte, blue phase-forming compositions consisting of nematic liquid crystals and chiral dopants undergo a response that can be observed with the naked eye, eliminating the need for additional steps. The VOCs can be detected in gaseous and liquid forms, and the sensitivity of the composition can be adjusted by changing the level of dopant concentration as well as adding non-volatile organics as sensitizing agents.

To address the problems of stability and dewetting, the inventors have developed a device that uses LC-phobic surfaces to isolate LC films within the microwells of an array. The LC films have uniform dimensions and are stabilized by capillary forces protecting against shock, gravity, heat and solvent exposure. They can be deposited via high throughput methods such as spin coating.

Applications

- Occupational and industrial hygiene
- Hazardous material processing

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- First-responder biological safety

Key Benefits

- Enhances detection of toxic aromatic compounds
- Can be observed with the naked eye – light polarizers are not needed
- Enables precise control and stability of liquid crystal films
- Can maintain history of transient exposure to a VOC or other analyte
- Augments electrochemical detection methods
- LCs do not require an alignment layer.

Stage of Development

The inventors have successfully tested numerous configurations with differing volatile compounds, chiral dopant levels and non-volatile aromatic additives over differing concentrations.

The development of this technology was supported by WARF Accelerator. WARF Accelerator selects WARF's most commercially promising technologies and provides expert assistance and funding to enable achievement of commercially significant milestones. WARF believes that these technologies are especially attractive opportunities for licensing.

Additional Information

Related Technologies

- For more information about liquid crystal-based compound detection, see WARF reference number P01228US.

Publications

- Pantoja M. A. B. and Abbot N. L. 2016. Surface-Controlled Orientational Transitions in Elastically Strained Films of Liquid Crystal That Are Triggered by Vapors of Toluene ACS Appl. Mater. Interfaces. 8, 13114–13122.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Sensors

For current licensing status, please contact Jennifer Gottwald at jennifer@warf.org or 608-960-9854

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