Analytical Instrumentation, Methods & Materials

Robust, Moldable Colloidal Liquid Crystal Gels Provide User-Friendly, Portable Sensors

View U.S. Patent No. 8,278,040 in PDF format.

WARF: P08443US02

Inventors: Nicholas Abbott, Ankit Agarwal, Santanu Pal

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing mechanically robust, self-supporting and moldable liquid crystal-containing material that responds to chemical and biological species in gas or liquid phases.

Overview

Liquid crystals can serve as molecular magnifying glasses, amplifying molecular and biomolecular events so they may be seen with the naked eye. Microwells and other microfabricated structures previously have been used to hold films of liquid crystals for sensing applications. However, these structures can be tedious to fabricate, difficult to fill with liquid crystals and prone to instabilities.

The Invention

UW-Madison researchers have developed self-supporting and mechanically robust gels that can be molded, easily handled and processed yet retain their responsiveness to chemical and biological species. These colloidal liquid crystal gels can be used to produce improved liquid crystal-based devices, including wearable, personalized sensors.

The gels are produced by dispersing liquid crystals into colloids, which spontaneously form a network. The combination of colloids and liquid crystals yields a visco-elastic gel that has high mechanical strength because of the network of colloids. The high strength allows the gels to be molded into any desired shape, making the detection of chemicals and biochemicals much easier than previous methods using liquid crystals.

Applications

- Screening for narcotics in blood and hair, biomarkers in food products, disease markers or exposure to environmental pollutants
- Preparation of stable and easily-imaged interfaces between liquid crystals and aqueous/air phases
- Label-free monitoring of aqueous solutions of biomolecules like surfactants and lipids
- Optical detection of ligand-receptor binding, specific protein binding events, enzyme catalyzed reactions or biomechanical stresses transmitted by mammalian cells
- Cell culture substrates

Key Benefits

- Because the gels have high mechanical strength and can be molded into any desired shape, they are much easier to use to detect chemical and biomolecular interactions than earlier methods using liquid crystals for similar purposes.
- Colloidal liquid crystal gel-based sensors do not require complex instrumentation, laborious techniques, labeling of the analyte or electrical power.
- Gels are simple and portable, so they can be used in diagnostic assays performed remotely or as wearable personalized sensors.
- Liquid crystals respond quickly, allowing dynamic phenomena to be followed at interfaces, such as adsorption of surfactants in aqueous phase.
- Gels are mechanically tunable with strengths of one to 100 KPa.
- Size and thickness of the liquid crystal domains in the colloidal liquid crystal gel films can be tuned on a micrometer scale.

- Gel surfaces can be designed with nanometer scale topographies for specific applications.
- Gels can be molded into birefringent optical films.

Publications

- Agarwal A., Huang E., Palecek S. and Abbott N.L. 2008. Optically Responsive and Mechanically Tunable Colloid-In-Liquid Crystal Gels That Support Growth of Fibroblasts. Adv. Mater. 20, 4804-4809.
- Pal S.K., Agarwal A. and Abbott N.L. 2009. Chemically Responsive Gels Prepared from Microspheres Dispersed in Liquid Crystals. Small. 5, 2589-2596.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Sensors
- Analytical Instrumentation, Methods & Materials : Sensors
- Research Tools : Detection

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