Method for Manipulating and Heating of Discrete Droplets Using Magnetic Particles Derived from Porous Silicon

Tech ID: 19787 / UC Case 2006-176-0

BACKGROUND

The control of materials in microscale quantities is of interest in a wide range of fields. A particular area of microscale material control that has drawn much attention is microfluidics. Heating techniques developed for use in microfluidic networks are problematic due to the requirement for efficiency in the localized heating of the individual droplets with minimal heat transfer to the surrounding area.

TECHNOLOGY DESCRIPTION

This technology is a method for precise local heating of small liquid volumes using magnetic porous Si microparticles. Dr. Sailor and his collaborators at UCSD have previously demonstrated that porous silicon photonic crystals can be engineered to have amphiphilic properties. Adding magnetite to the particles endows them with the ability to be manipulated with magnetic fields, providing a means to direct the motion of liquid droplets in microfluidics applications.

By application of an alternating magnetic field the properties of the porous Si particles are utilized for manipulating and heating the droplet. The particle includes a hydrophilic host layer with magnetic nanoparticles and a hydrophobic encoding layer that define a spectral code. The droplets can be therefore identified using a light spectrum reflected from the encoding layer. In addition, the particle structure allows an efficient heat transfer from the magnetic layer to the droplet.

ADVANTAGES

- Efficient heat transfer from the magnetic layer to the droplet
- Multi-layer porous magnetic particle adhere to the surface of a drop
- Externally applied electromagnetic stimulus heats the particles with the associated droplet
- Heating of droplets that can be identified by a unique spectral code
- Discrete microliter-scale liquid droplets
- Ability of the porous Si host to localize high concentration of magnetite nanoparticles allows heating at relatively low fields
- Level of heating related to the number of microparticles introduced into a host droplet, and their degree of magnetization
- Group of discrete droplets can be simultaneously heated to different temperatures using a single coil

APPLICATIONS

Tagging, manipulating and heating small volumes of liquids.

The small size of the particles facilitates ready incorporation into various hosts, e.g. test kits, assays, powders, liquids, glass, paper, and *in vivo* detection is enabled by the biocompatible silicon particles. The technology has a variety of applications, including:

- *In vivo* drug delivery and labeling
- Biological screening and labeling
- High-throughput screening of molecules for genomics and proteomics
- Drug discovery
- Chemical labeling
- Optical signaling and displays
- Product marking
- Security identification

STATE OF DEVELOPMENT

CONTACT

University of California, San Diego
Office of Innovation and Commercialization
innovation@ucsd.edu
tel: 858.534.5815.

OTHER INFORMATION

KEYWORDS

heating, discrete, droplet, magnetic, porous, silicon, photonic, crystals, microfluidics, microparticles

CATEGORIZED AS

- **Medical**
  - Delivery Systems

RELATED CASES

2006-176-0

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

UCSD RESEARCHER

Michael J. Sailor, Ph.D., is Professor in the Department of Chemistry and Biochemistry at UCSD.

RELATED MATERIALS

- Park, J.-H.; Derfus, A. M.; Segal, E.; Vecchio, K. S.; Bhatia, S. N.; Sailor, M. J., Local Heating of Discrete Droplets Using Magnetic Porous Silicon-Based Photonic Crystals. J. Am. Chem. Soc. 2006, 128 (24), 7938-7946.
- Sailor Research Group
- Michael J. Sailor

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,377,147	02/19/2013	2006-176

University of California, San Diego
Office of Innovation and Commercialization
9500 Gilman Drive, MC 0910, ,
La Jolla,CA 92093-0910

Tel: 858.534.5815
innovation@ucsd.edu
https://innovation.ucsd.edu
Fax: 858.534.7345