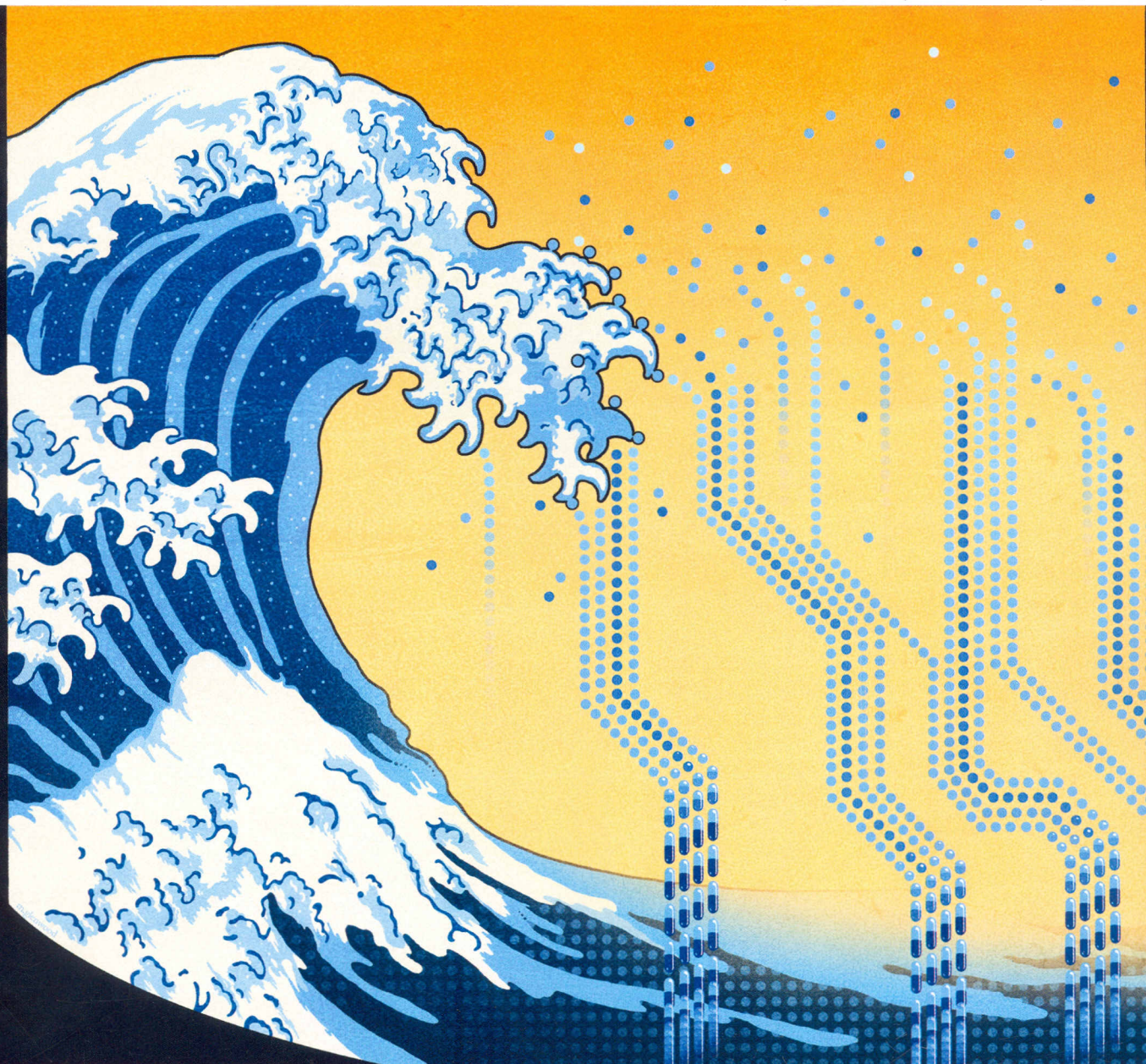


# Lab on a Chip

Miniaturisation for chemistry, physics, biology, materials science and bioengineering

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**EDITORIAL:**  
Ingber and Whitesides.  
Lab on a Chip: United States of America



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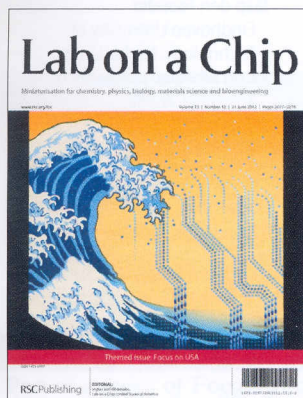
# Lab on a Chip

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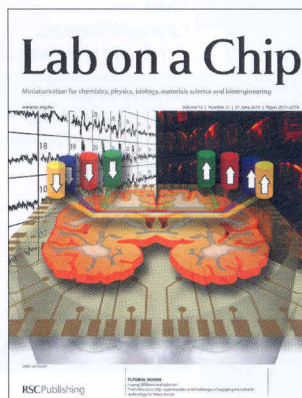
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## IN THIS ISSUE

ISSN 1473-0197 CODEN LCAHAM 12(12) 2077-2278 (2012)



**Cover**  
See Ingber and Whitesides, pp. 2089–2090. Poster image for the Wyss Symposium on MICROFLUIDICS AND MEDICINE: Accelerating the Flow to the Clinic, held in Boston, MA USA, May 2011, which inspired this issue. Image created by Michael Glenwood Gibbs, Hecht Design and Don Ingber, and provided by the Wyss Institute at Harvard University. Image reproduced by permission of Donald Ingber from *Lab Chip*, 2012, 12, 2089.



**Inside cover**  
See Huang *et al.*, pp. 2103–2117. Image reproduced by permission of Yu Huang from *Lab Chip*, 2012, 12, 2103.

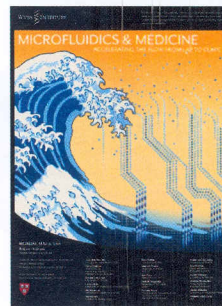
## EDITORIAL

2089

### Lab on a Chip: United States of America

Donald E. Ingber and George M. Whitesides

The Wyss Institute Symposium on "Microfluidics and Medicine: Accelerating the Flow from Lab to the Clinic", which inspired this issue, focused on work in the microfluidics field that promises to have a transformative impact on medicine and clinical care.



## PROFILE

2091

### Contributors to the USA issue

*Lab on a Chip* profiles the contributors to the USA issue.



## HIGHLIGHT

2094

### Research highlights

Šeila Selimović, Cole A. DeForest, Mehmet R. Dokmeci and Ali Khademhosseini\*

Predicting localized ligand-based cell signaling – Anisotropic supraparticles generated using microfluidics – Microfluidics for micro-immunohistochemistry.



## FOCUS

2097

### Microfluidic synthesis of multifunctional Janus particles for biomedical applications

Shikuan Yang, Feng Guo, Brian Kiraly, Xiaole Mao, Mengqian Lu, Kam W. Leong and Tony Jun Huang\*

Tony Jun Huang and co-workers discuss microfluidic synthesis of multifunctional Janus particles for biomedical applications – Part of a series of Focus articles elucidating bio-related issues that impact on lab on a chip and microfluidic research.



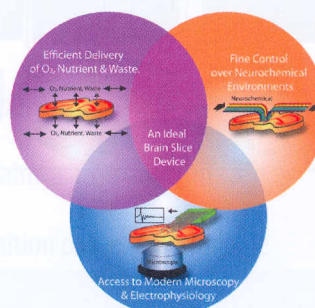
## TUTORIAL REVIEW

2103

### Brain slice on a chip: opportunities and challenges of applying microfluidic technology to intact tissues

Yu Huang, Justin C. Williams\* and Stephen M. Johnson

Isolated brain tissue, especially brain slices, are valuable experimental tools for studying neuronal function at the network, cellular, synaptic, and single channel levels.



## CRITICAL REVIEWS

2118

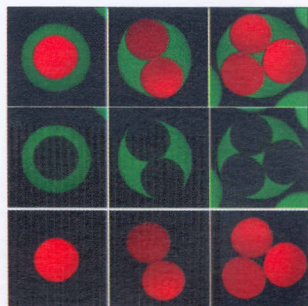
### Commercialization of microfluidic point-of-care diagnostic devices

Curtis D. Chin, Vincent Linder\* and Samuel K. Sia\*

We review current work and challenges in commercializing LOC technologies for POC diagnostics, including lessons learned at Claros Diagnostics.



2135

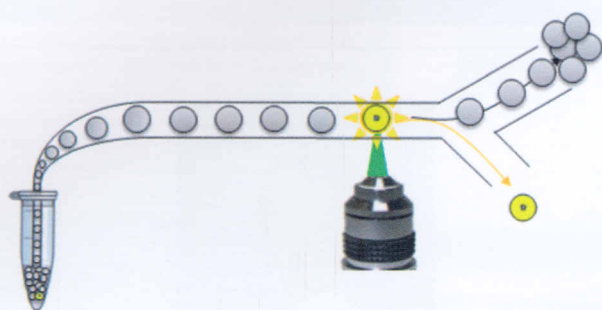


### Microfluidic synthesis of advanced microparticles for encapsulation and controlled release

Wynter J. Duncanson, Tina Lin, Adam R. Abate, Sebastian Seiffert, Rhutesh K. Shah and David A. Weitz\*

The control afforded by droplet microfluidics enables precise control of microparticles for encapsulation and controlled release applications.

2146



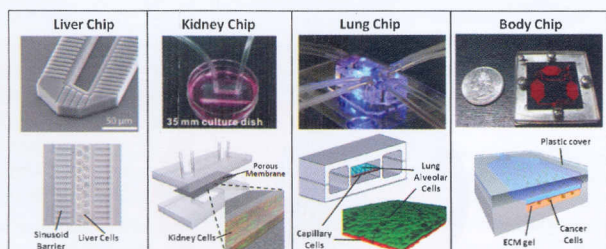
### Droplet microfluidics for high-throughput biological assays

Mira T. Guo, Assaf Rotem, John A. Heyman and David A. Weitz\*

Droplet microfluidics enables new high-throughput screening applications by using picolitre volumes, kilohertz manipulation and measurement speeds, and high effective concentrations.

## FRONTIER

2156



### Microengineered physiological biomimicry: Organs-on-Chips

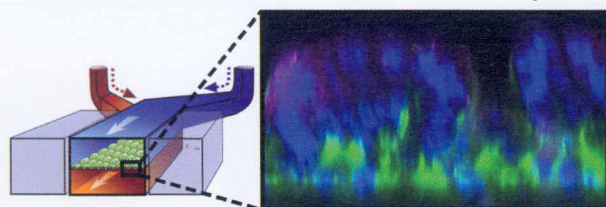
Donggeun Huh, Yu-suke Torisawa, Geraldine A. Hamilton, Hyun Jung Kim and Donald E. Ingber\*

Microscale engineering technologies provide unprecedented opportunities to create cell culture microenvironments that go beyond current three-dimensional *in vitro* models by recapitulating the critical tissue-tissue interfaces, spatiotemporal chemical gradients, and dynamic mechanical microenvironments of living organs.

## PAPERS

2165

### Human Peristaltic Gut-on-a-Chip

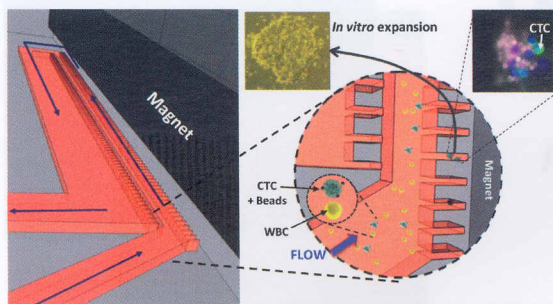


### Human gut-on-a-chip inhabited by microbial flora that experiences intestinal peristalsis-like motions and flow

Hyun Jung Kim, Donggeun Huh, Geraldine Hamilton and Donald E. Ingber\*

Biomimetic 'human gut-on-a-chip' recapitulates the complex structure and physiology of living intestine, including peristalsis-like motions, flow and microbial symbionts.

2175

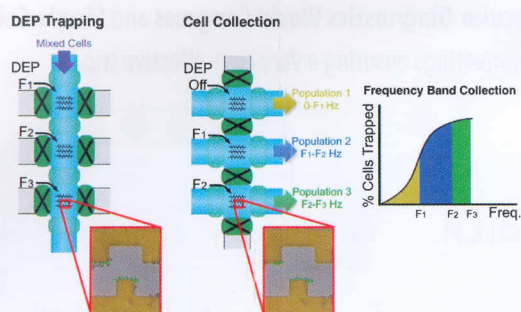


### A combined micromagnetic-microfluidic device for rapid capture and culture of rare circulating tumor cells

Joo H. Kang, Silva Krause, Heather Tobin, Akiko Mammoto, Mathumai Kanapathipillai and Donald E. Ingber\*

A combined micromagnetic-microfluidic device has been developed for rapid isolation of rare circulating tumor cells (CTCs) from mammary cancer-bearing mice with high (~90%) efficiency, and *in vitro* expansion of the retrieved CTCs for additional analytical studies.

2182

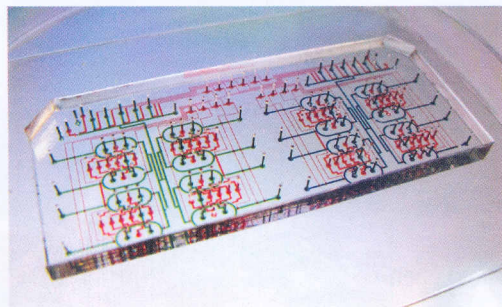


### Frequency discretization in dielectrophoretic assisted cell sorting arrays to isolate neural cells

Javier L. Prieto,\* Jente Lu, Jamison L. Nourse, Lisa A. Flanagan and Abraham P. Lee\*

A dielectrophoretic assisted cell sorting (DACs) device for the enrichment of neurons from a heterogeneous population of mixed neural cells (neural stem/progenitor cells (NSPCs) and neurons) by selective frequency band trapping.

2190

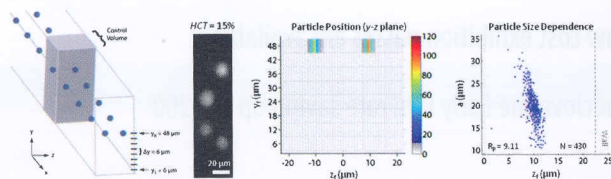


### High throughput automated chromatin immunoprecipitation as a platform for drug screening and antibody validation

Angela R. Wu, Tiara L.A. Kawahara, Nicole A. Rapicavoli, Jan van Riggelen, Emelyn H. Shroff, Liwen Xu, Dean W. Felsher, Howard Y. Chang and Stephen R. Quake

An automated microfluidic-based, high-throughput platform for chromatin immunoprecipitation screening that is sensitive enough to detect cytokine-induced cellular epigenetic changes over a fine temporal resolution.

2199

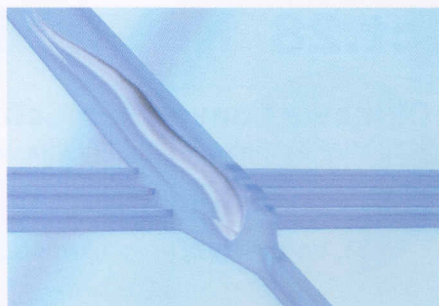


### Visualization of microscale particle focusing in diluted and whole blood using particle trajectory analysis

Eugene J. Lim, Thomas J. Ober, Jon F. Edd, Gareth H. McKinley and Mehmet Toner

Using Nd:YAG laser illumination and CCD camera detection of fluorescently labeled particles, we demonstrate the ability to resolve individual particles in diluted and whole blood moving at mean particle velocities up to  $1.85 \text{ m s}^{-1}$ .

2211

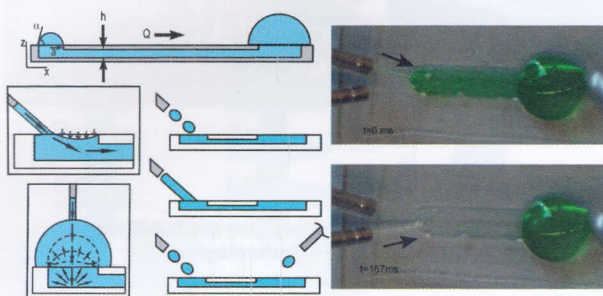


### A microfluidic device for whole-animal drug screening using electrophysiological measures in the nematode *C. elegans*

Shawn R. Lockery,\* S. Elizabeth Hulme, William M. Roberts, Kristin J. Robinson, Anna Laromaine, Theodore H. Lindsay, George M. Whitesides and Janis C. Weeks

This paper describes the fabrication and use of a microfluidic device for performing whole-animal chemical screens using non-invasive electrophysiological readouts of neuromuscular function in the nematode worm, *C. elegans*.

2221

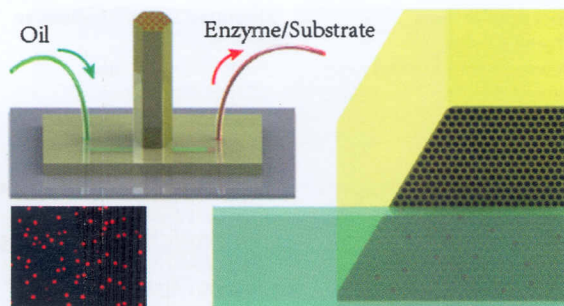


### An inertia enhanced passive pumping mechanism for fluid flow in microfluidic devices

Pedro J. Resto, Erwin Berthier, David J. Beebe and Justin C. Williams\*

We investigate the transfer of momentum in liquid ejected from micronozzles to an open surface-tension based pumping channel, define flow regimes where inertia is significant and demonstrate applications such as on-the-fly mixing at the inlet, filling of empty microchannels, rapid fluidic exchanges inside the channel and instantaneous reversal of flow.

2229

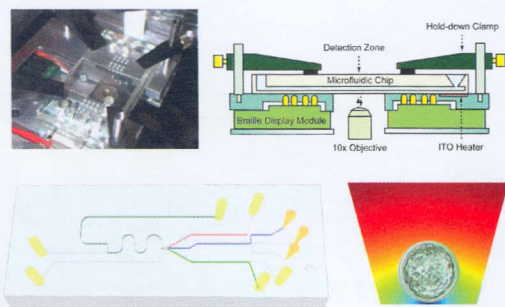


### Oil-sealed femtoliter fiber-optic arrays for single molecule analysis

Huaibin Zhang, Shuai Nie, Candice M. Eton, Raymond M. Wang and David R. Walt\*

We present a method for sealing high-density arrays of femtoliter-sized aqueous reaction chambers with a droplet of oil.

2240

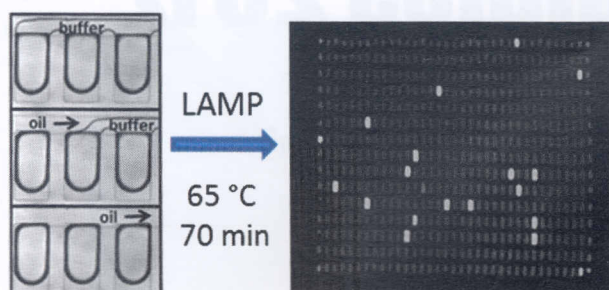


### Real time culture and analysis of embryo metabolism using a microfluidic device with deformation based actuation

Yun Seok Heo, Lourdes M. Cabrera, Charles L. Bormann, Gary D. Smith\* and Shuichi Takayama\*

A computerized microfluidic real time embryo culture and assay device is able to measure time dependent nutrient consumption by single or multiple live mouse blastocyst-stage embryos with  $\text{pmol h}^{-1}$  sensitivity.

2247

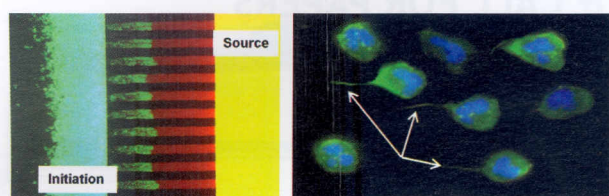


### Digital LAMP in a sample self-digitization (SD) chip

Alexander Gansen,\* Alison M. Herrick, Ivan K. Dimov, Luke P. Lee and Daniel T. Chiu

We report successful digital isothermal Loop-mediated DNA amplification (dLAMP) in a sample self-digitization chip. Chip operation is simple and allows for loss-less sample digitization on-chip, which are desirable properties in point-of-care diagnostics.

2255

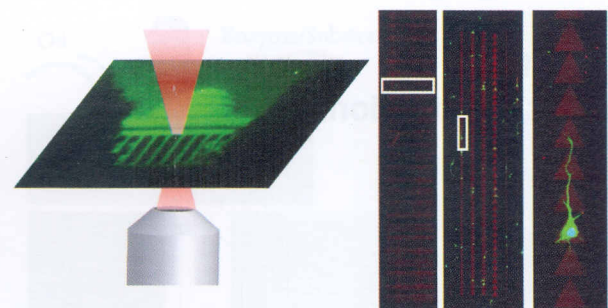


### Targeting the leukocyte activation cascade: Getting to the site of inflammation using microfabricated assays

Enoch Kim, Olivier Schueller and Paul M. Sweetnam\*

The combination of soft lithography and surface chemistry enables the preparation of devices used in the study of the impact of chemokines on several components of the leukocyte activation cascade.

2265



### Ultra-rapid laser protein micropatterning: screening for directed polarization of single neurons

Mark A. Scott, Zachary D. Wissner-Gross and Mehmet Fatih Yanik\*

We present a rapid laser protein-micropatterning method using multi-photon photobleaching of fluorophores, and direct the polarization of single neurons using triangle ratchets.