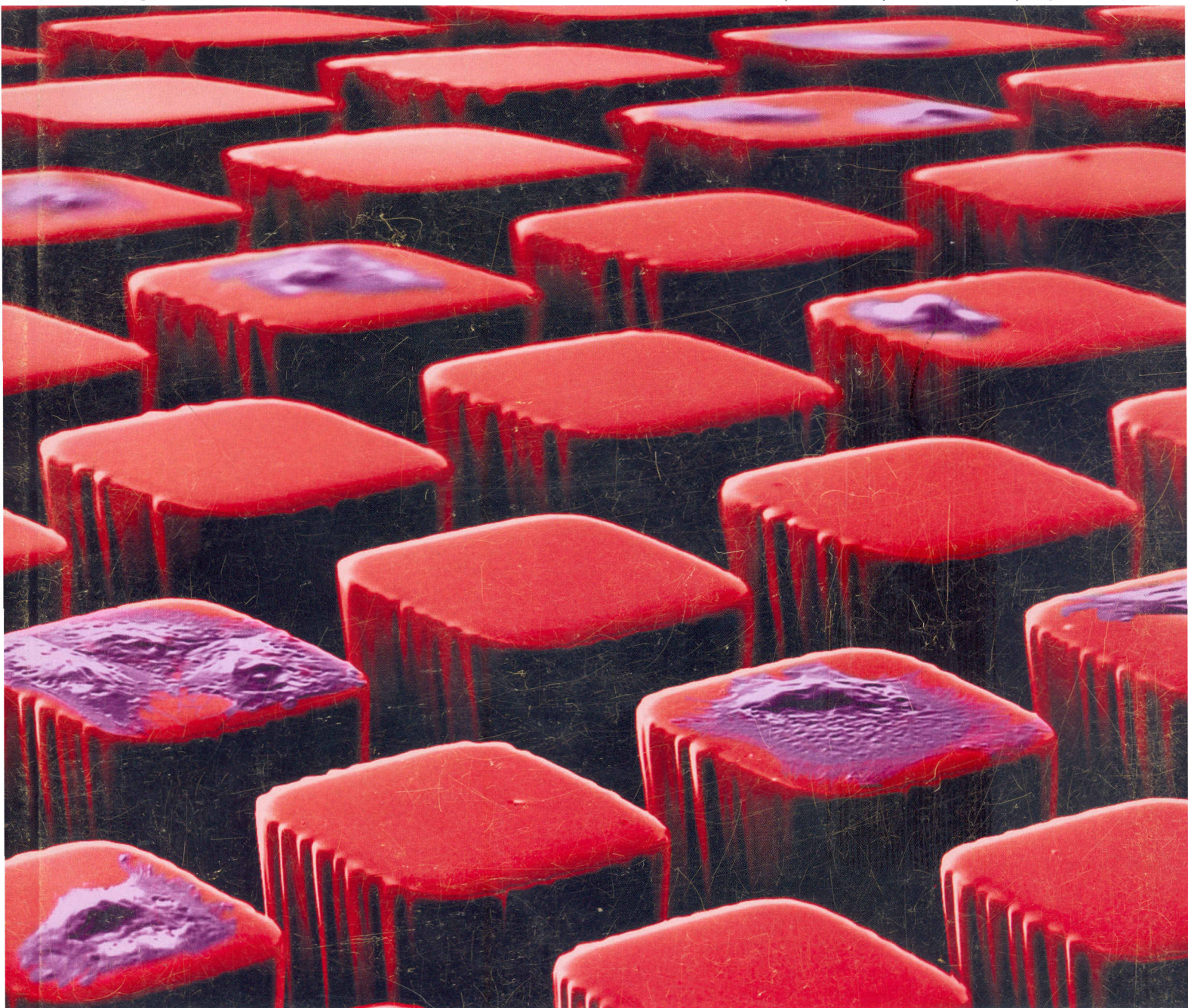


# Lab on a Chip

Micro- & nano- fluidic research for chemistry, physics, biology, & bioengineering

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**EDITORIAL**  
Gaitan and Locascio  
Art in Science



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Art in Science.

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### Inside cover

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Nanomanipulation using near field photonics.

Image reproduced by permission of David Erickson from *Lab Chip*, 2011, **11**, 995.

## EDITORIAL

993

### Art in Science

Michael Gaitan and Laurie Locascio

Michael Gaitan and Laurie Locascio introduce the 3rd annual  $\mu$ TAS Art in Science award presented in October 2010.



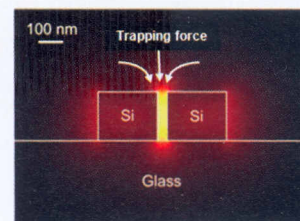
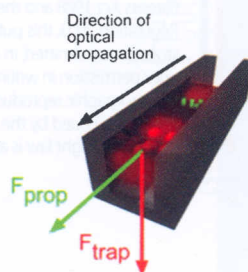
## CRITICAL REVIEW

995

### Nanomanipulation using near field photonics

David Erickson,\* Xavier Serey, Yih-Fan Chen and Sudeep Mandal

In this article we review the use of near-field photonics for trapping, transport and handling of nanomaterials.

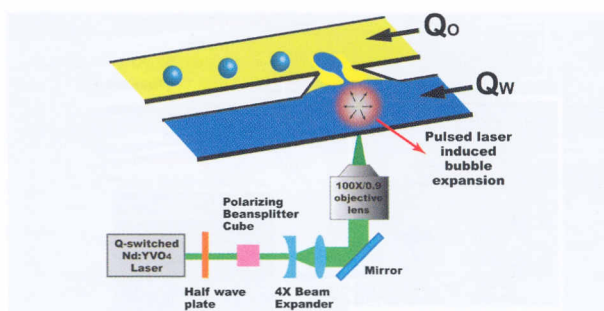


1010

### High-speed droplet generation on demand driven by pulse laser-induced cavitation

Sung-Yong Park,\* Ting-Hsiang Wu, Yue Chen, Michael A. Teitell and Pei-Yu Chiou\*

We report on an ultra-fast, pulse laser-driven droplet generation (PLDG) mechanism enabling on-demand droplet generation at rates up to 10 000 droplets per second.



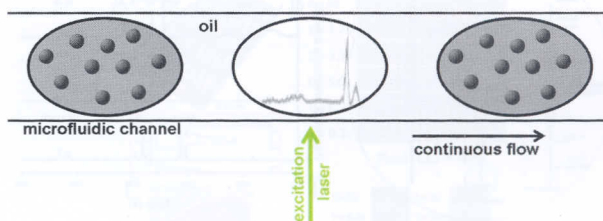
PAPERS

1013

### Towards a fast, high specific and reliable discrimination of bacteria on strain level by means of SERS in a microfluidic device

Angela Walter, Anne März, Wilm Schumacher, Petra Röscher and Jürgen Popp\*

A new approach for bacterial classification implemented in a microfluidic device is presented. A large database (11 200) is established to classify *E. coli* on strain level.

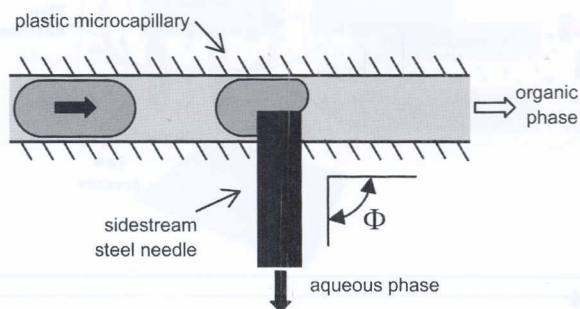


1022

### The separation of immiscible liquid slugs within plastic microchannels using a metallic hydrophilic sidestream

Frederik Scheiff,\* Matthias Mendorf, David Agar, Nuno Reis and Malcolm Mackley

New method and pressure-balance model for separation of organic-aqueous slugs using a plastic microcapillary film and a hydrophilic hypodermic needle.

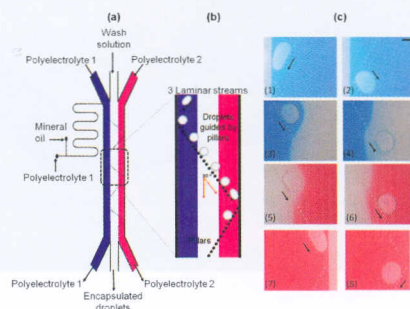


1030

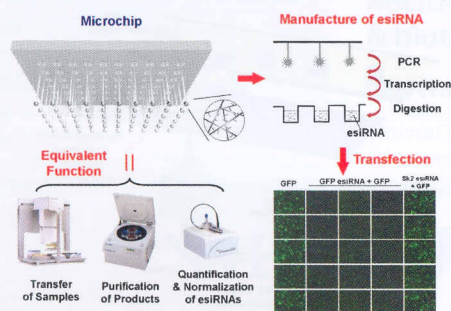
### A 'microfluidic pinball' for on-chip generation of Layer-by-Layer polyelectrolyte microcapsules

Chaitanya Kantak, Sebastian Bayer, Levent Yobas, Tushar Bansal and Dieter Trau\*

Inspired by the game of "pinball" where rolling metal balls are guided by obstacles, here we describe a novel microfluidic technique which utilizes micropillars in a flow channel to continuously generate, encapsulate and guide Layer-by-Layer (LbL) polyelectrolyte microcapsules.



1036

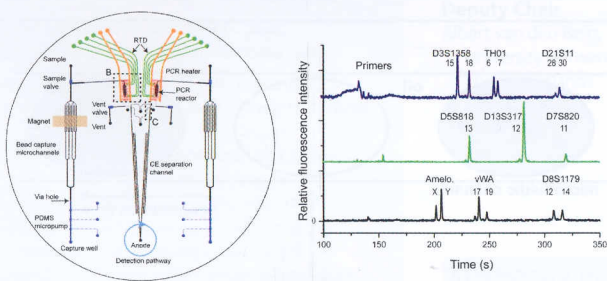


### A polyacrylamide microbead-integrated chip for the large-scale manufacture of ready-to-use esiRNA

Huang Huang, Qing Chang, Changhong Sun, Shenyi Yin, Juan Li and Jianzhong Jeff Xi\*

The integrated chip enables the convenient transfer, purification, quantification or normalization of hundreds of products in parallel, thus demonstrating a simple and robust method for the large-scale manufacture of esiRNAs.

1041

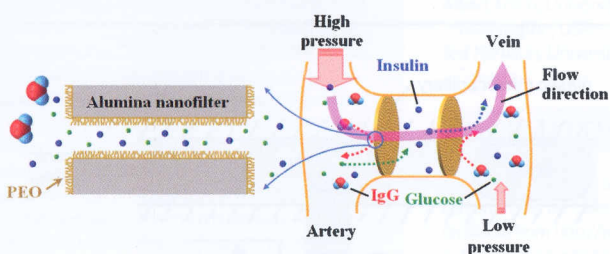


### Integrated DNA purification, PCR, sample cleanup, and capillary electrophoresis microchip for forensic human identification

Peng Liu, Xiujun Li, Susan A. Greenspoon, James R. Scherer and Richard A. Mathies\*

A fully integrated microsystem consisting of DNA purification, PCR, post-PCR cleanup, and capillary electrophoresis for performing entire forensic short tandem repeat typing on a single device.

1049

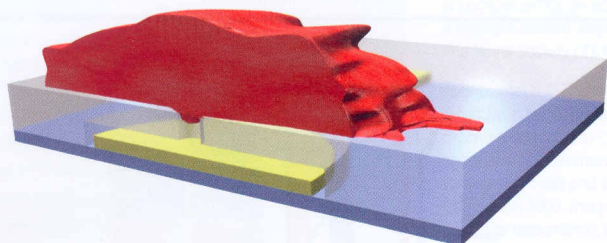


### A polyethylene oxide-functionalized self-organized alumina nanochannel array for an immunoprotection biofilter

Sangmin Lee, Min Park, Heon-Seok Park, Yeongae Kim, Siwoo Cho, Jae Hyung Cho,\* Jaesung Park\* and Woonbong Hwang\*

We first report optimized nanochannel biofilter with superior immunoprotection, antifouling properties and the high permeability of nutrients, which have excellent mechanical stability under *in vivo* condition.

1054



### Nanocavity electrode array for recording from electrogenic cells

Boris Hofmann, Enno Kätelhön, Manuel Schottdorf, Andreas Offenhäusser and Bernhard Wolfrum\*

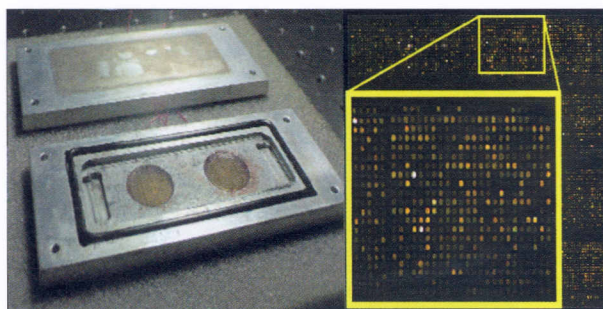
We present a new nanocavity sensor array for highly localized recordings from electrogenic cells growing on a chip.

1059

### DNA hybridization enhancement using piezoelectric microagitation through a liquid coupling medium

Kiattimant Rodaree, Thitima Matusos, Sastra Chaotheing,\*  
Tawee Pogfay, Nattida Suwanakitti,  
Chayapat Wongsombat, Kata Jaruwongrunsee,  
Anurat Wisitsoraat, Sumalee Kamchonwongpaisan,  
Tanom Lomas and Adisorn Tuantranont\*

Piezoelectric microagitation through a liquid coupling medium is employed on DNA microarray chips. This scheme substantially reduces DNA hybridization time and increases efficiency compared to conventional method.

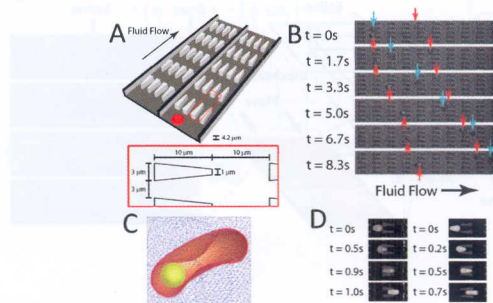


1065

### A microfabricated deformability-based flow cytometer with application to malaria

Hansen Bow, Igor V. Pivkin, Monica Diez-Silva,  
Stephen J. Goldfless, Ming Dao, Jacquin C. Niles,  
Subra Suresh and Jongyoon Han\*

Here we introduce an automated microfabricated “deformability cytometer” that measures dynamic mechanical responses of  $10^3$  to  $10^6$  individual RBCs in a cell population.

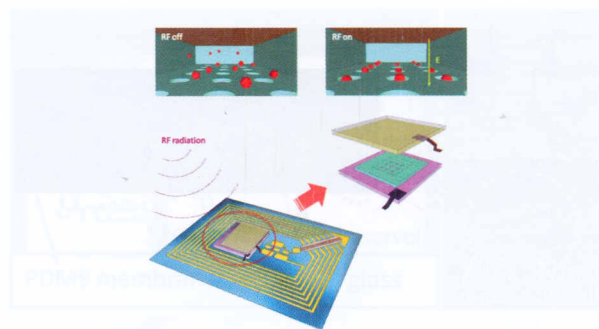


1074

### Wirelessly powered microfluidic dielectrophoresis devices using printable RF circuits

Wen Qiao,\* Gyoujin Cho and Yu-Hwa Lo

We report the first wirelessly powered microfluidic device integrated with a printed RF circuit, which eliminates the entire need for wire attachments and external instruments.

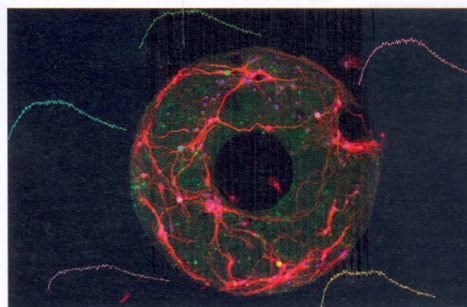


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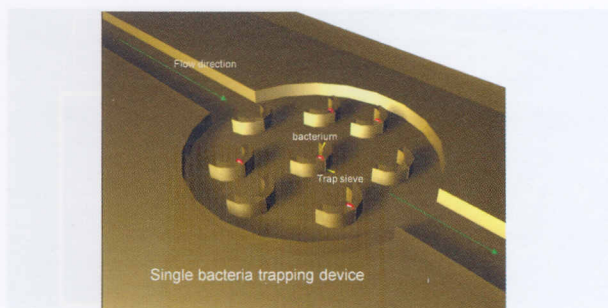
### Ring-shaped neuronal networks: a platform to study persistent activity

Ashwin Vishwanathan, Guo-Qiang Bi  
and Henry C. Zeringue\*

We have developed a platform to create small ring-shaped *in vitro* neuronal networks used to consistently generate persistent activity.



1089

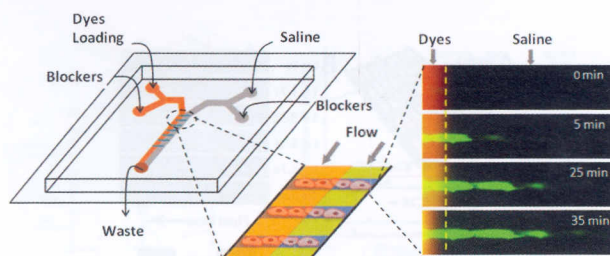


### Programmed trapping of individual bacteria using micrometre-size sieves

Min-Cheol Kim, Brett C. Isenberg, Jason Sutin, Amit Meller, Joyce Y. Wong and Catherine M. Klapperich\*

We have built and simulated a hydrodynamic sieving device capable of trapping individual bacteria without the use of chemical surface treatments. The trapped cells can be continuously supplied with media and optically monitored while trapped.

1096

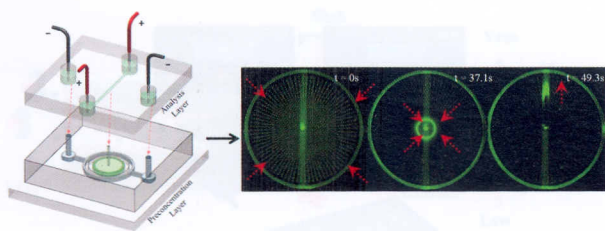


### Assay for molecular transport across gap junction channels in one-dimensional cell arrays

Nannan Ye, Cédric Bathany and Susan Z. Hua\*

A microfluidic chip capable of measuring molecular diffusion *via* gap junction channels in one-dimensional cell arrays.

1102

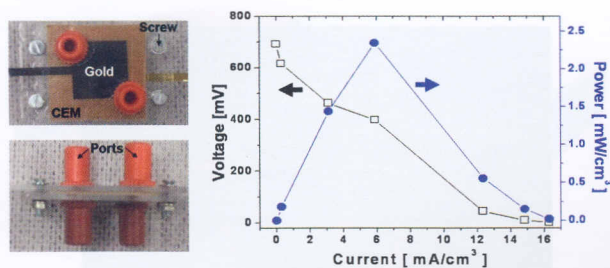


### Radial sample preconcentration

Brent Scarff, Carlos Escobedo and David Sinton\*

Radial preconcentration is demonstrated whereby analyte is focused centrally through radial concentration polarization. Sample analytes are focused into the centre, creating a concentrated plug that is injected vertically into the microfluidic analysis layer.

1110



### A $\mu\text{L}$ -scale micromachined microbial fuel cell having high power density

Seokheun Choi,\* Hyung-Sool Lee, Yongmo Yang, Prathap Parameswaran, César I. Torres, Bruce E. Rittmann and Junseok Chae

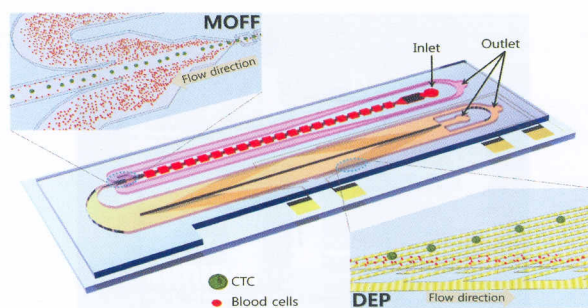
We report a MEMS (Micro-Electro-Mechanical Systems)-based microbial fuel cell (MFC) that produces a high power density.

1118

### Continuous separation of breast cancer cells from blood samples using multi-orifice flow fractionation (MOFF) and dielectrophoresis (DEP)

Hui-Sung Moon, Kiho Kwon, Seung-II Kim, Hyunju Han, Joohyuk Sohn, Soohyeon Lee and Hyo-II Jung\*

We developed a microfluidic device for separating CTCs from blood by combining multi-orifice flow fractionation (MOFF) and dielectrophoresis (DEP) which enables high-speed continuous flow-through separation without any labeling.

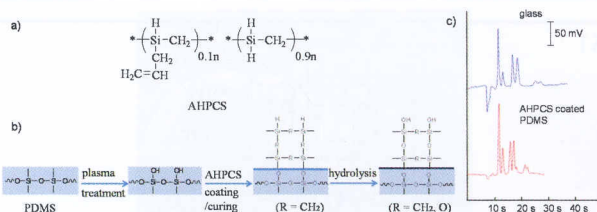


1126

### Silicate glass coated microchannels through a phase conversion process for glass-like electrokinetic performance

Ming Li and Dong Pyo Kim\*

Conversion of a 100 nm thick coating of allylhydridopolycarbosilane (AHPCS) on a PDMS substrate to silicate glass layer by phase conversion is presented. The silicate glass coated PDMS channel presents electrokinetic properties which are comparable to those of native glass channels.

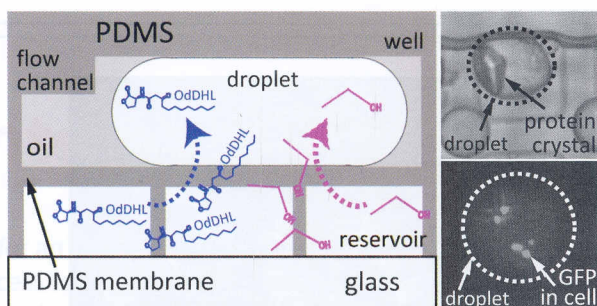


1132

### Controlling the contents of microdroplets by exploiting the permeability of PDMS

Jung-uk Shim, Santoshkumar N. Patil, James T. Hodgkinson, Steven D. Bowden, David R. Spring, Martin Welch, Wilhelm T.S. Huck,\* Florian Hollfelder\* and Chris Abell\*

The protein crystallization and gene expression *in vivo* can be controlled by transporting small molecules through PDMS membrane to manipulate the chemical environment of microdroplets.

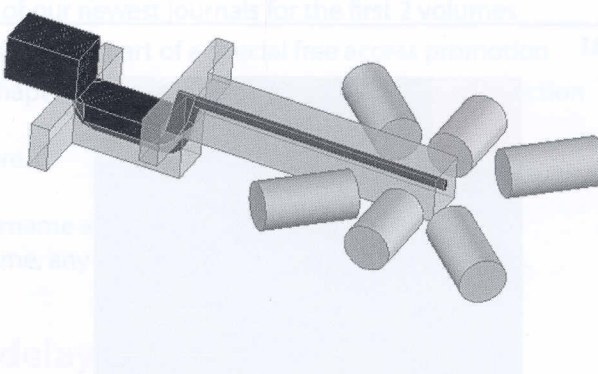


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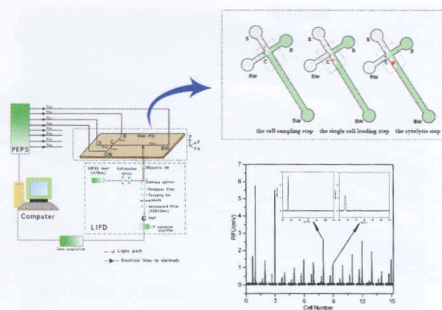
### Hydrodynamic optical alignment for microflow cytometry

Matthew J. Kennedy, Scott J. Stelick, Lavanya G. Sayam, Andrew Yen, David Erickson and Carl A. Batt\*

A device and method are described for aligning a microparticle stream with an illumination zone in a microfabricated flow cytometer.



1144



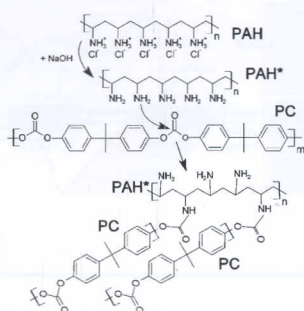
### Electrokinetic gated injection-based microfluidic system for quantitative analysis of hydrogen peroxide in individual HepG2 cells

Xinyuan Zhang, Qingling Li, Zhenzhen Chen, Hongmin Li, Kehua Xu, Lisheng Zhang and Bo Tang\*

Single cell injection, cytolysis, electrophoresis separation and determination of  $\text{H}_2\text{O}_2$  in single cells were automatically performed using the electrokinetic gated injection-based microfluidic system.

### TECHNICAL NOTES

1151

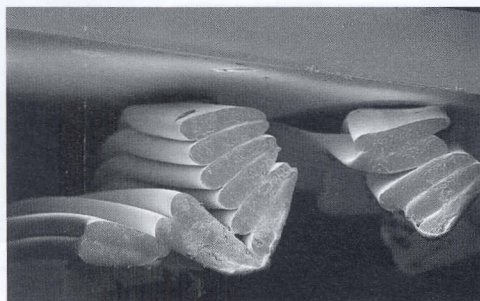


### Hydrophilic polycarbonate for generation of oil in water emulsions in microfluidic devices

Ladislav Derzsi, Paweł Jankowski, Wojciech Lisowski and Piotr Garstecki\*

This report details the method for rendering hydrophilic surfaces of microchannels fabricated in polycarbonate (PC).

1157

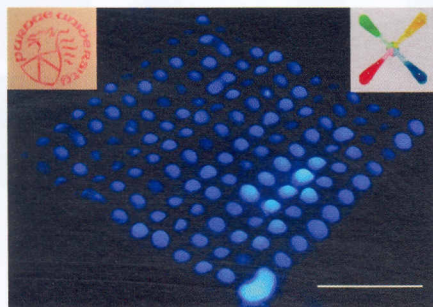


### UV polymerization of hydrodynamically shaped fibers

Abel L. Thangawng, Peter B. Howell, Jr, Christopher M. Spillmann, Jawad Naciri and Frances S. Ligler\*

Flat acrylate fibers were shaped using hydrodynamic focusing and polymerized using UV light. Shapes and sizes could be predetermined using grooves in the microchannel walls and the control of flow-rate ratios of the sheath and prepolymer solutions.

1161



### Laser-treated hydrophobic paper: an inexpensive microfluidic platform

Girish Chitnis, Zhenwen Ding, Chun-Li Chang, Cagri A. Savran and Babak Ziaie\*

Creating hydrophilic patterns on a hydrophobic paper using laser treatment for applications such as a microfluidic platform or microzone plates for bio-detection assays.

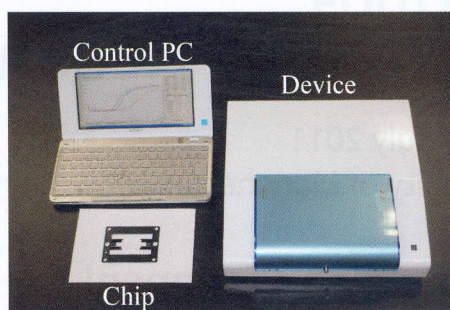


1166

**Point-of-care testing system enabling 30 min detection of influenza genes**

Tomoteru Abe, Yuji Segawa, Hidetoshi Watanabe, Tasuku Yotoriyama, Shinichi Kai, Akio Yasuda, Norio Shimizu and Naoko Tojo

A nucleic acid amplification test system realizing influenza virus detection at the point-of-care is ready for practical use.

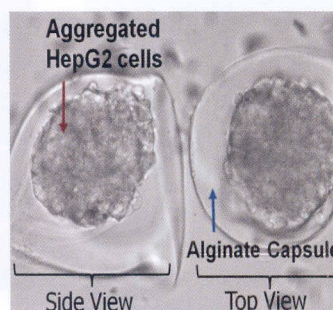


1168

**Diffusion-mediated *in situ* alginate encapsulation of cell spheroids using microscale concave well and nanoporous membrane**

Kwang Ho Lee, Da Yoon No, Su-Hwan Kim, Ji Hee Ryoo, Sau Fung Wong and Sang-Hoon Lee\*

The developed encapsulation method is useful for handling and controlling spheroids because transport and preservation of encapsulated spheroids is much easier than for non-encapsulated spheroids.



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