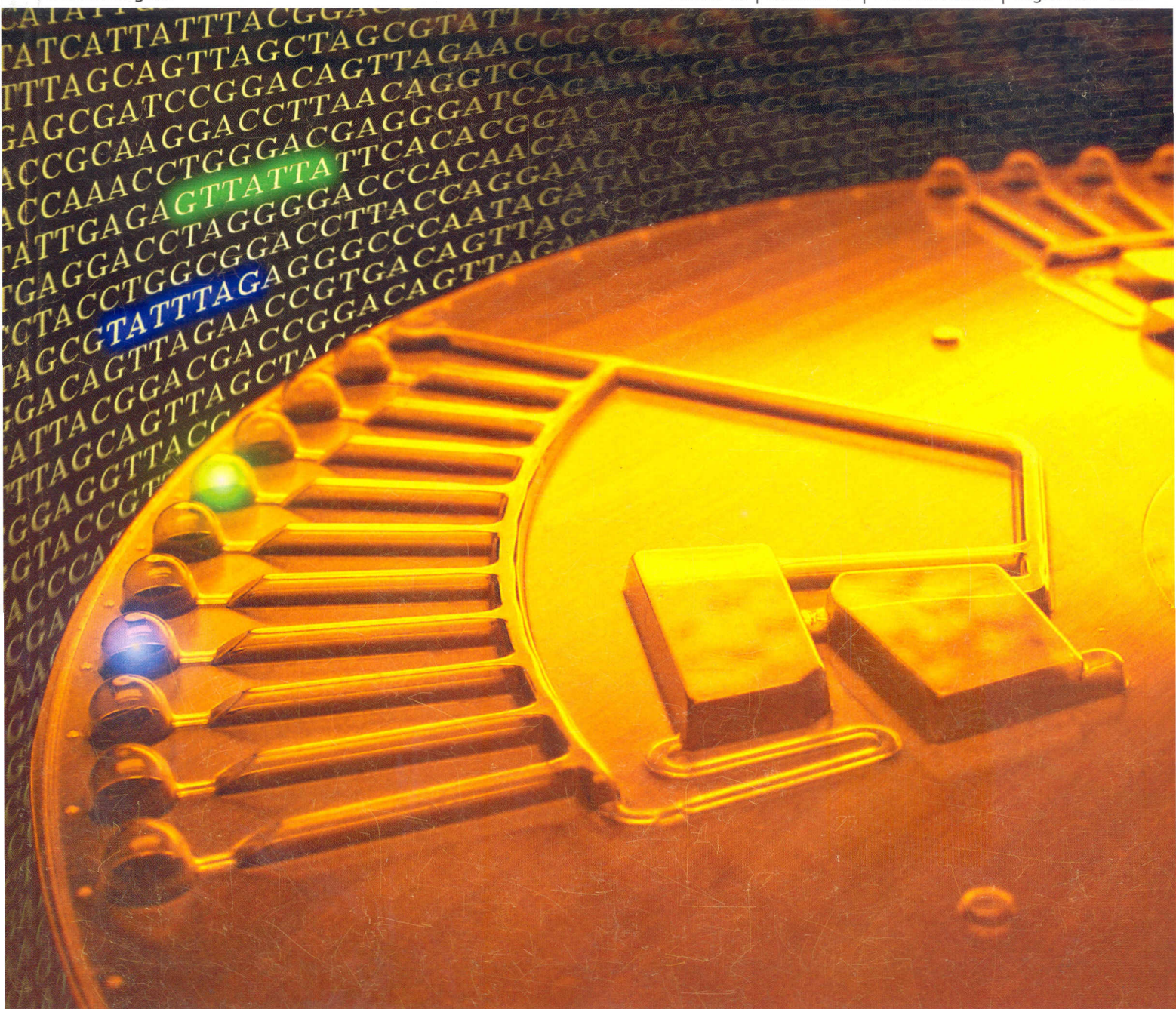


Lab on a Chip

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

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RSC Publishing

Focke *et al.*
Microstructuring of polymer films

van Steijn *et al.*
Predictive model for bubbles



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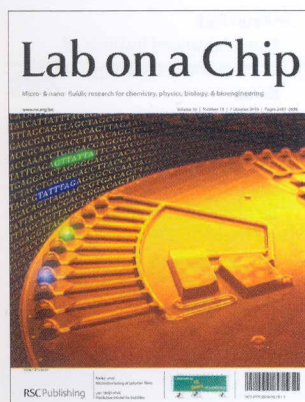
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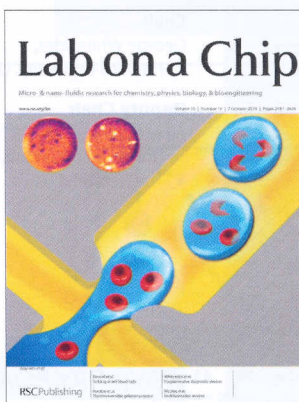
IN THIS ISSUE

ISSN 1473-0197 CODEN LCAHAM 10(19) 2481–2636 (2010)



Cover

See Focke *et al.*, pp. 2519–2526. A centrifugal microfluidic disk for genotyping by real-time PCR: Lab chips made of polymer films revolutionise sample processing. Image reproduced by permission of Maximilian Focke from *Lab Chip*, 2010, **10**, 2519.



Inside cover

See Baroud *et al.*, pp. 2505–2512. Red blood cells are encapsulated in microfluidic drops, while the carrier oil provides transport but also as a sink of Oxygen. The cells, which suffer from sickle cell anemia, go through a polymerisation which is detected using polarization microscopy. Image reproduced by permission of Charles Baroud from *Lab Chip*, 2010, **10**, 2505.

HIGHLIGHT

2495

Research Highlights

Petra S. Dittrich*

Petra Dittrich reviews the current literature in miniaturisation and related technologies.



FOCUS

2497

Non scholae sed vitae discimus!

Holger Becker discusses the needs and structures of microfluidics education—part of a series of Focus articles on the commercialization of microfluidics.

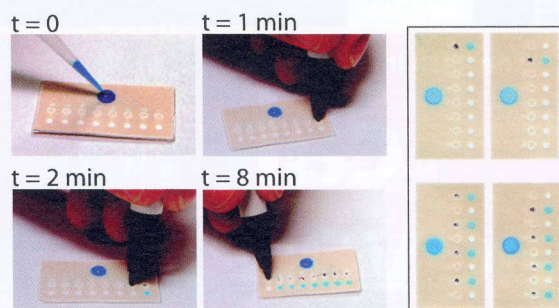


2499

Programmable diagnostic devices made from paper and tape

Andres W. Martinez, Scott T. Phillips, Zhihong Nie, Chao-Min Cheng, Emanuel Carrilho, Benjamin J. Wiley and George M. Whitesides*

The paper describes three-dimensional microfluidic paper-based analytical devices (3-D μ PADs) that can be programmed (postfabrication) by the user to generate multiple patterns of flow through them.

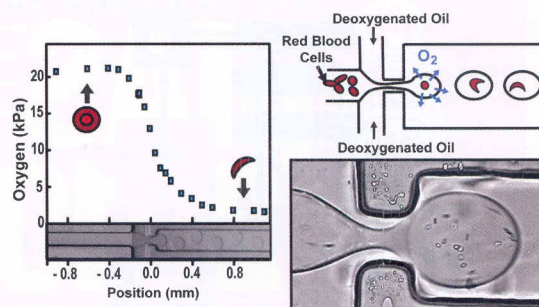


2505

Sickling of red blood cells through rapid oxygen exchange in microfluidic drops

Paul Abbyad, Pierre-Louis Tharaux, Jean-Louis Martin, Charles N. Baroud* and Antigoni Alexandrou*

A novel approach to study the sickling of red blood cells is presented. It is based on rapidly varying the oxygen within flowing microdroplets by using the carrier oil as a sink or source of oxygen.

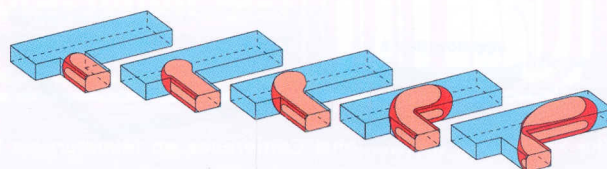


2513

Predictive model for the size of bubbles and droplets created in microfluidic T-junctions

Volkert van Steijn*, Chris R. Kleijn and Michiel T. Kreutzer

We present a closed expression that allows the reader to predict the size of bubbles and droplets created in T-junctions without fitting. Our simple model explains why the size of bubbles and droplets strongly depends on the shape of a T-junction, teaches how the shape can be tuned to obtain the desired size, and was successfully validated with our experiments.



2519

Microstructuring of polymer films for sensitive genotyping by real-time PCR on a centrifugal microfluidic platform

M. Focke, F. Stumpf, B. Faltin, P. Reith, D. Bamarni, S. Wadle, C. Müller, H. Reinecke, J. Schrenzel, P. Francois, D. Mark, G. Roth, R. Zengerle* and F. von Stetten

A novel process flow for microstructuring of polymer films is used to fabricate microfluidic cartridges. The implemented genotyping assay is fully validated by testing 22 DNA samples including diverse clinical isolates from patients infected by methicillin-resistant *Staphylococcus aureus* (MRSA). The limit of detection is well below 10 copies of DNA per reaction well.

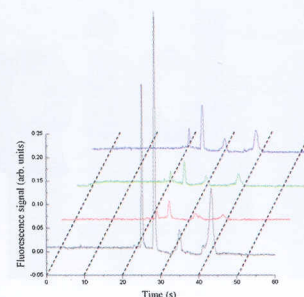
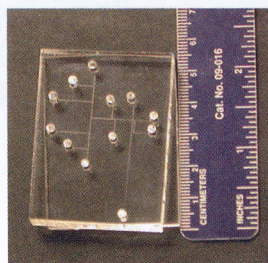


2527

Microdevices integrating affinity columns and capillary electrophoresis for multibiomarker analysis in human serum

Weichun Yang, Ming Yu, Xiuhua Sun
and Adam T. Woolley*

Integrated microdevices (left) with an affinity column and capillary electrophoresis channels can purify and quantitate multiple biomarkers in human serum using an on-chip calibration curve (right).

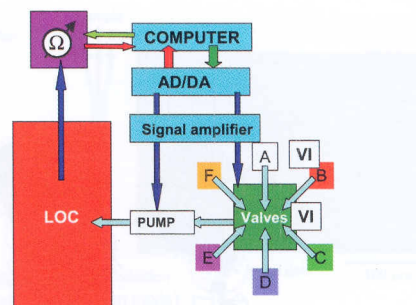


2534

Lab-on-a-chip for label free biological semiconductor analysis of Staphylococcal Enterotoxin B

Minghui Yang, Steven Sun, Hugh Alan Bruck,
Yordan Kostov and Avraham Rasooly*

Functional elements of multi-channel lab on a chip for biological semiconductor based detection.

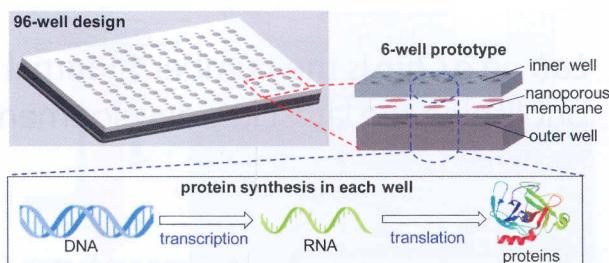


2541

Protein synthesis in a device with nanoporous membranes and microchannels

Qian Mei, Ruba Khnouf, Andrew Simon and Z. Hugh Fan*

Cell-free protein synthesis was implemented in an array device consisting of inner wells and outer wells. A nanoporous membrane and a microchannel were integrated for supplying nutrients from the outer wells to the inner wells where reactions took place.

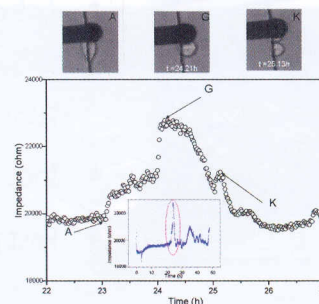


2546

Monitoring impedance changes associated with motility and mitosis of a single cell

Lamya Ghenim,* Hirokazu Kaji, Yu Hoshino,
Takeshi Ishibashi, Vincent Haguët, Xavier Gidrol
and Matsuhiko Nishizawa

We present a device that probes the mitosis of a single cell by impedance measurements. Cells are attracted by positive dielectrophoresis to the sub-millimetre electrode surface. Different phases of mitosis are distinguished in the impedance trace.

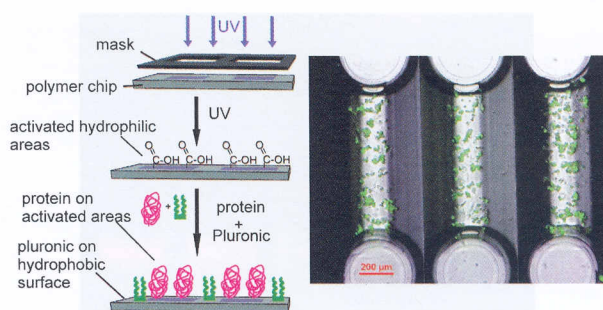


2551

A method for patterned *in situ* biofunctionalization in injection-molded microfluidic devices

Julia Schütte, Christian Freudigmann, Karin Benz, Jan Böttger, Rolf Gebhardt and Martin Stelzle*

UV-irradiation prior to bonding enables site selective biofunctionalization in completed microfluidic systems. A simple rinsing step creates patterned protein coatings which promote cell adhesion.

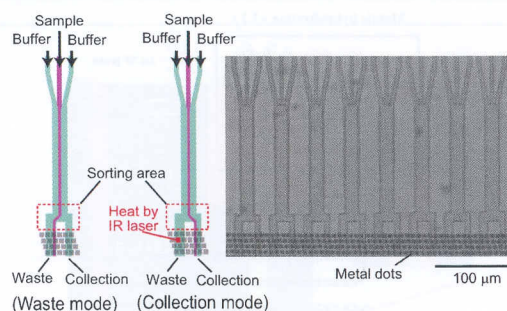


2559

Integration in a multilayer microfluidic chip of 8 parallel cell sorters with flow control by sol–gel transition of thermoreversible gelation polymer

Hirokazu Sugino, Takahiro Arakawa, Yuki Nara, Yoshitaka Shirasaki, Kazuto Ozaki, Shuichi Shoji and Takashi Funatsu*

Layout and operating principle of the 8 parallel sorters integrated in a microfluidic chip. Flow switching was performed by a heat-induced sol–gel transition of thermoreversible gelation polymer.

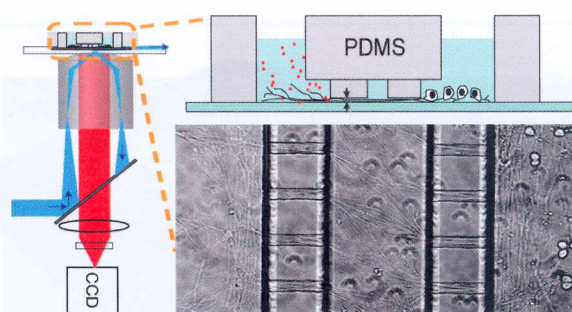


2566

Single-molecule imaging of NGF axonal transport in microfluidic devices

Kai Zhang, Yasuko Osakada, Marija Vrljic, Liang Chen, Harsha V. Mudrakola and Bianxiao Cui*

A microfluidic chamber is designed and tested to achieve critical background reduction for single-molecule imaging in neurons. Successful measurement of nerve growth factor transport suggests that microfluidic devices can serve as a unique platform for studying the axonal transport process.

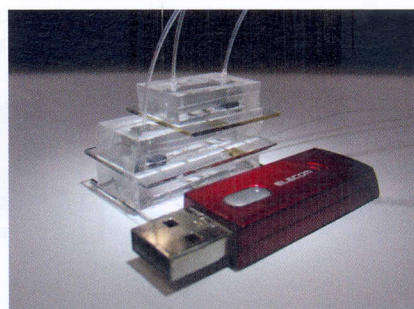


2574

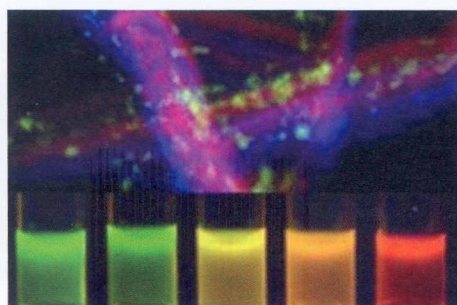
Automatic, sequential power generation for prolonging the net lifetime of a miniature biofuel cell stack

Takeo Miyake,* Masato Oike, Syuhei Yoshino, Yohei Yatawaga, Keigo Haneda and Matsuhiko Nishizawa*

We developed a sequential power generation system, in which each of the stacked enzyme fuel cells was designed to be exposed sequentially to fuel solution by automatically switched fuel flow.



2579

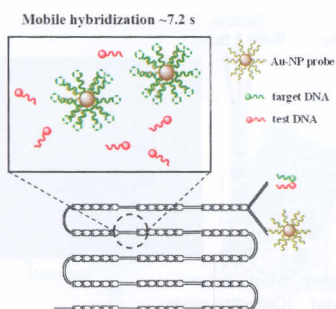


Sequential microfluidic flow synthesis of CePO_4 nanorods decorated with emission tunable quantum dots

Jie Fang,* Cameron W. Evans, Glen J. Willis, David Sherwood, Yanglong Guo, Guanzhong Lu, Colin L. Raston and K. Swaminathan Iyer*

CePO_4 nanorods decorated with quantum dots (QDs@ CePO_4) can be prepared in a sequential, aqueous procedure under continuous flow using a rotating tube processor and a narrow channel reactor with tunable emission.

2583

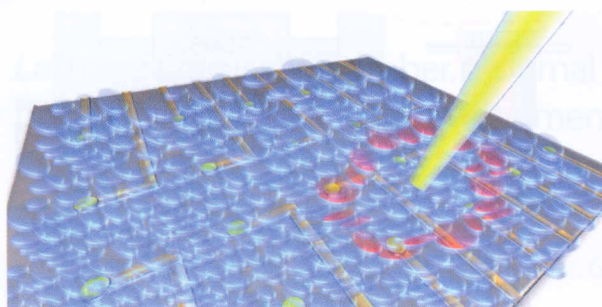


Enhanced mobile hybridization of gold nanoparticles decorated with oligonucleotide in microchannel devices

Miao-Hsing Hsu, Wei-Feng Fang, Yu-Hsuan Lai, Jing-Tang Yang,* Tsung-Lin Tsai and Dar-Bin Shieh

We investigated mobile hybridization between a target DNA and an Au-NP probe in a microfluidic device using fluorescence quenching for detection; test DNA served as a control.

2588

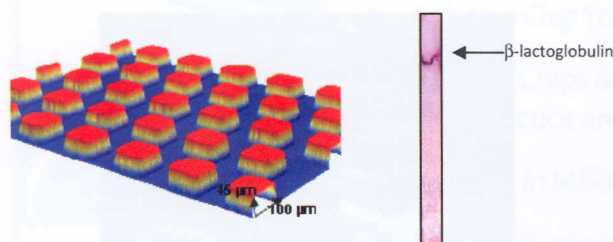


Light induced stimulation and delay of cardiac activity

Boris Hofmann, Vanessa Maybeck, Stefan Eick, Simone Meffert, Sven Ingebrandt, Philip Wood, Ernst Bamberg and Andreas Offenhäusser*

The first use of ChR2 in cardiac cells allows action potential generation and pacemaker suppression as shown by MEA recordings.

2597



Micropillar array chips toward new immunodiagnosis

Hong-Yi Li, Virginie Dauriac, Valerie Thibert, Hélène Senechal, Gabriel Peltre, Xin-Xiang Zhang* and Stéphanie Descroix*

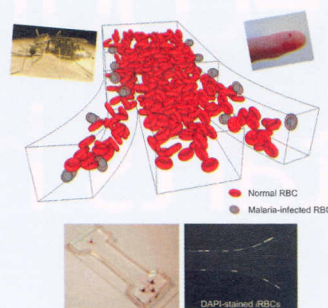
In this paper, we demonstrate the possibility to use a micropillar array (45 μm in height, 100 $\times$ 100 μm square cross section) to perform molecular immunodiagnosis.

2605

Deformability based cell margination—A simple microfluidic design for malaria-infected erythrocyte separation

Han Wei Hou, Ali Asgar S. Bhagat, Alvin Guo Lin Chong, Pan Mao, Kevin Shyong Wei Tan, Jongyoon Han* and Chwee Teck Lim*

In this paper, the hemodynamic phenomenon of cell margination is mimicked for the separation of malaria-infected red blood cells from whole blood based on their reduced deformability.



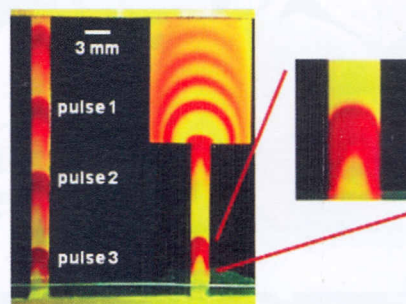
TECHNICAL NOTES

2614

Visualization and measurement of flow in two-dimensional paper networks

Peter Kauffman, Elain Fu, Barry Lutz and Paul Yager*

2DPN is a versatile new microfluidic format for performing complex chemical processes. To design 2DPNs, it is necessary to predict 2D flow patterns and velocities within them. In this note, we demonstrate electrochemical and fluorescence methods for visualization of flow in 2DPNs.

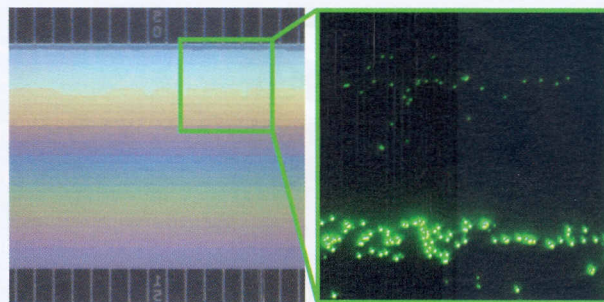


2618

Separation and metrology of nanoparticles by nanofluidic size exclusion

Samuel M. Stavis,* Jon Geist and Michael Gaitan

The integrated size separation and measurement of a mixture of nanoparticles by three-dimensional nanofluidic size exclusion are demonstrated.

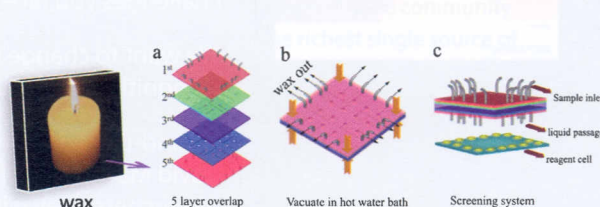


2622

Wax-bonding 3D microfluidic chips

Xiuqing Gong, Xin Yi, Kang Xiao, Shunbo Li, Rimantas Kodzius, Jianhua Qin* and Weijia Wen*

A simple, low-cost and detachable microfluidic chip incorporates easily accessible paper, glass slides or other polymer films as the chip materials along with adhesive wax as the recycling bonding material.



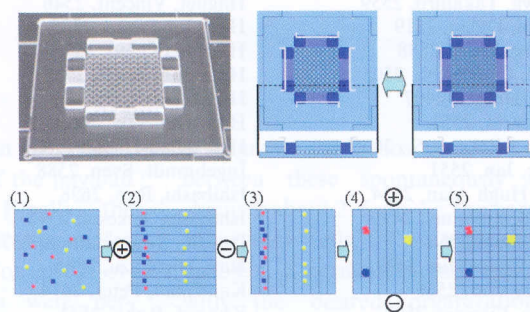
TECHNICAL NOTES

2628

Two-step perpendicular free-solution isoelectric focusing in a microchamber array chip

Ryo Ishibashi, Takehiko Kitamori and Kiyohito Shimura*

A free-solution microfluidic chip device enables rapid and high-resolution fractionation based on the principle of two-step perpendicular isoelectric focusing (IEF).

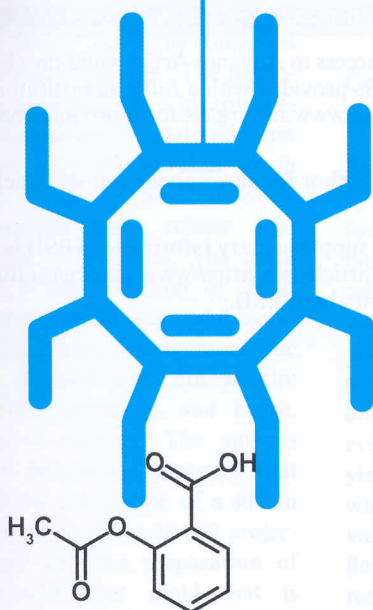
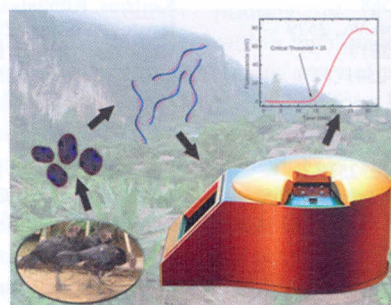


2632

Rapid detection of viral RNA by a pocket-size real-time PCR system

Pavel Neuzil,* Novak Lukas, Juergen Pipper, Shinhan Lee, Lisa F. P. Ng and Chunyan Zhang

We present an economical battery powered real-time reverse transcription polymerase chain reaction (real-time RT-PCR) system suitable for field and point-of-care applications; it has built-in thermal management, fluorescence-based detection system, and a single chip controller with touch-screen graphic display.



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