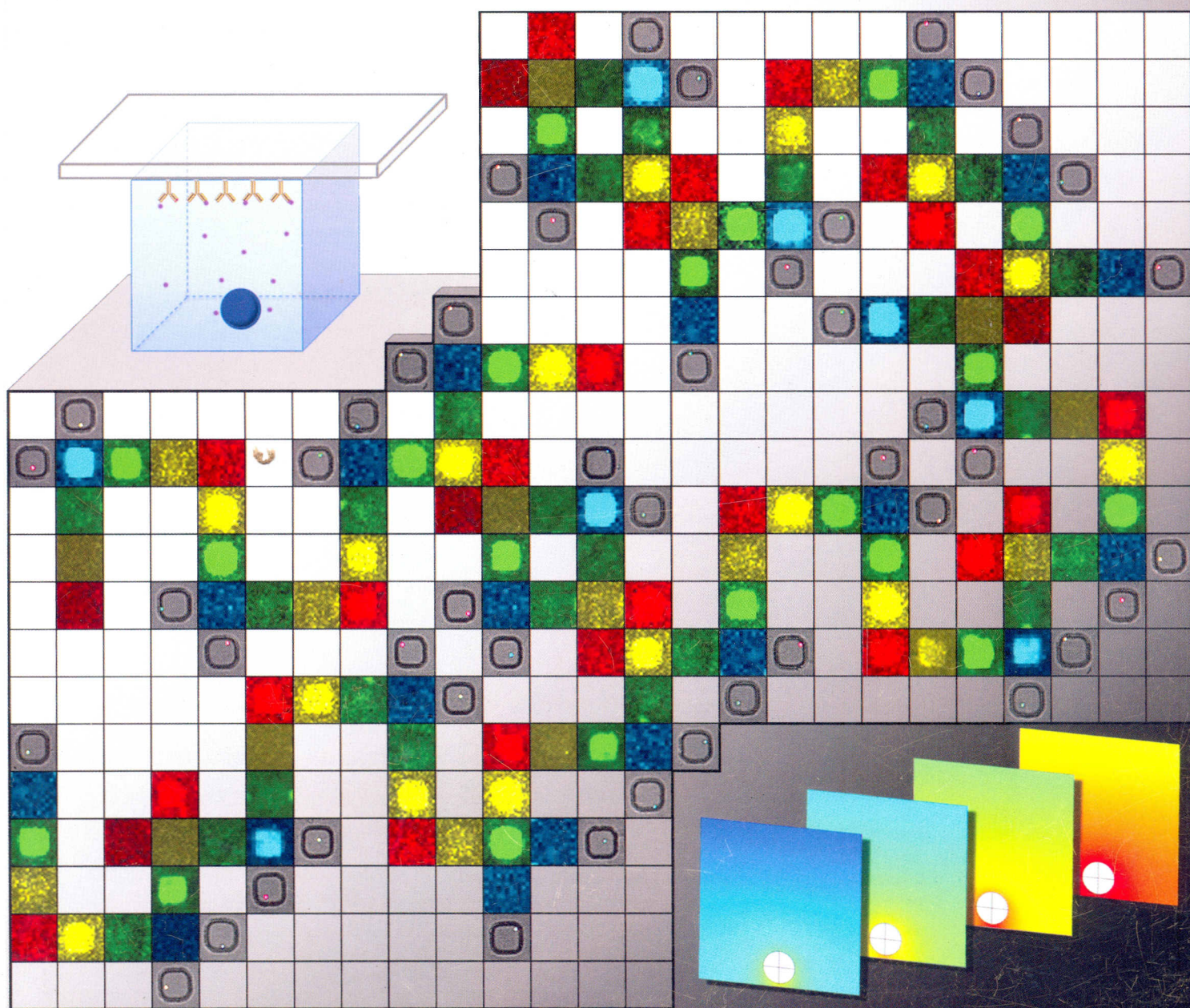


Lab on a Chip

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

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Volume 10 | Number 11 | 7 June 2010 | Pages 1337–1492



ISSN 1473-0197

RSC Publishing

Love
Analysis of cytokine secretion

Ozcan
Lensless on-chip microscope



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Lab on a Chip

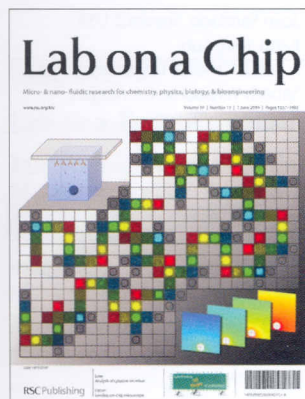
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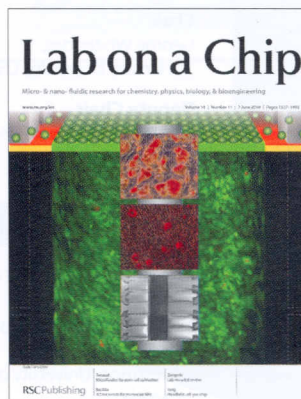
IN THIS ISSUE

ISSN 1473-0197 CODEN LCAHAM 10(11) 1337–1492 (2010)



Cover

See Love *et al.*, pp. 1391–1400.
A method using arrays of microwells permits quantification of the frequencies and rates of secretion of up to four cytokines from 10,000–100,000 live cells. Image reproduced by permission of Qing Han, Elizabeth M. Bradshaw, Björn Nilsson, David A. Hafler and J. Christopher Love from *Lab Chip*, 2010, **10**, 1391.



Inside cover

Fat cells and bone-forming cells developed from mesenchymal stem cells after 3 weeks on-chip. Substrate modifications prevented cells from settling in transverse channels and thus limit medium perfusion. Birgitte Prebensen is acknowledged for technical assistance with the cover design. Image reproduced by permission of Ellen Tenstad, Anna Tourovskaia, Albert Folch, Ola Myklebost and Edith Rian from *Lab Chip*, 2010, **10**, 1401.

HIGHLIGHT

1349

Research Highlights

Petra S. Dittrich*

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



FOCUS

1351

Collective wisdom

Holger Becker*

Holger Becker interviews several experienced industry contacts—part of a series of Focus articles on the commercialization of microfluidics.

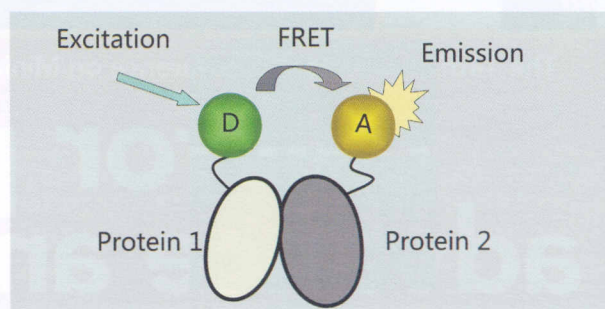


1355

FRET for lab-on-a-chip devices — current trends and future prospects

Smitha S. Varghese, Yonggang Zhu,* Timothy J. Davis and Stephen C. Trowell*

This article reviews the use of the FRET technique to monitor intra- and intermolecular reactions in lab-on-a-chip devices and discusses the future prospects.



1365

Lab-on-a-Foil: microfluidics on thin and flexible films

Maximilian Focke, Dominique Kosse, Claas Müller, Holger Reinecke, Roland Zengerle* and Felix von Stetten

This critical review is motivated by an increasing interest of the microfluidics community in developing complete Lab-on-a-Chip solutions based on thin and flexible foils (Lab-on-a-Foil).



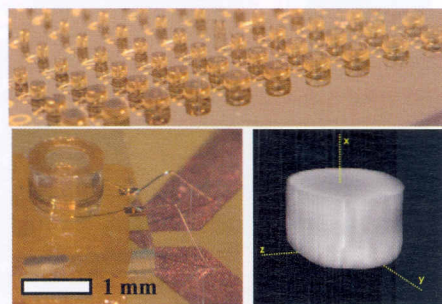
COMMUNICATION

1387

On-chip three dimensional microcoils for MRI at the microscale

V. Badilita,* K. Kratt, N. Baxan, M. Mohammadzadeh, T. Burger, H. Weber, D. v. Elverfeldt, J. Hennig, J. G. Korvink and U. Wallrabe

Solenoidal microcoils with submillimeter diameter dramatically increase the sensitivity of MR signal reception at the microscale. This is the first report on a MEMS compatible process to fabricate 3D microcoils for microscale MRI/NMR. We demonstrate the imaging capabilities of these solenoidal microcoils by imaging a phantom of CuSO_4 -doped water with an isotropic resolution of 25 μm .



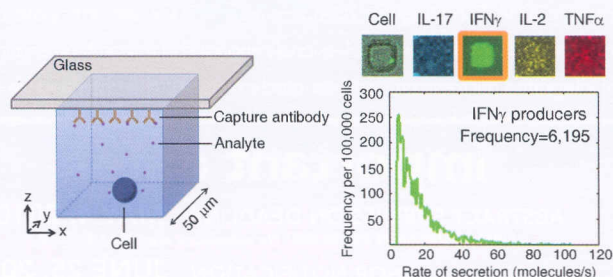
PAPERS

1391

Multidimensional analysis of the frequencies and rates of cytokine secretion from single cells by quantitative microengraving

Qing Han, Elizabeth M. Bradshaw, Björn Nilsson, David A. Hafler and J. Christopher Love*

Using a dense, elastomeric array of microwells, we developed a process to quantify the rates of secretion for multiple proteins simultaneously from individual live cells. Combined with imaging cytometry, this approach makes it possible to identify and recover cells based on their lineages and secreted factors.

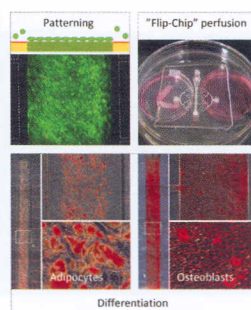


1401

Extensive adipogenic and osteogenic differentiation of patterned human mesenchymal stem cells in a microfluidic device

Ellen Tenstad,* Anna Tourovskaia, Albert Folch, Ola Myklebost and Edith Rian

We demonstrate the use of a microfluidic platform for long-term cultivation (3 weeks) of human mesenchymal stem-like cells (MSCs), a cell population of high interest for tissue engineering.

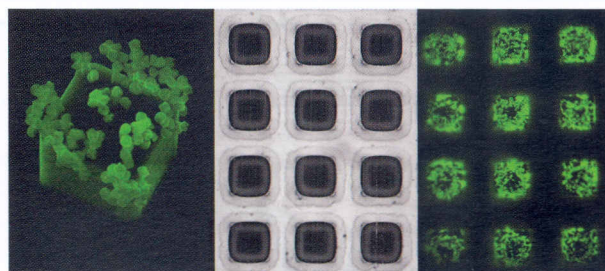


1410

High-resolution microcontact printing and transfer of massive arrays of microorganisms on planar and compartmentalized nanoporous aluminium oxide

Colin Ingham,* Johan Bomer, Ad Sprenkels, Albert van den Berg, Willem de Vos and Johan van Hylckama Vlieg

Viable microorganisms were contact printed at high throughput and resolution onto planar nanoporous aluminium oxide and into the microwells of subdivided culture chips to create massive, miniaturized arrays of microcolonies.

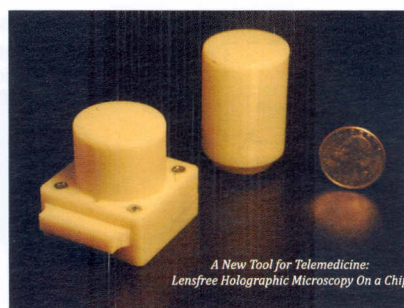


1417

Compact, light-weight and cost-effective microscope based on lensless incoherent holography for telemedicine applications

O. Mudanyali, D. Tseng, C. Oh, S. O. Isikman, I. Sencan, W. Bishara, C. Oztoprak, S. Seo, B. Khademhosseini and A. Ozcan*

We demonstrate a fully functional lensfree on-chip microscope weighing ~ 46 grams with dimensions smaller than $4.2\text{ cm} \times 4.2\text{ cm} \times 5.8\text{ cm}$ that achieves sub-cellular resolution over a large field of view of $\sim 24\text{ mm}^2$.

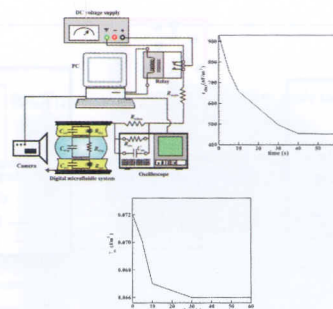


1429

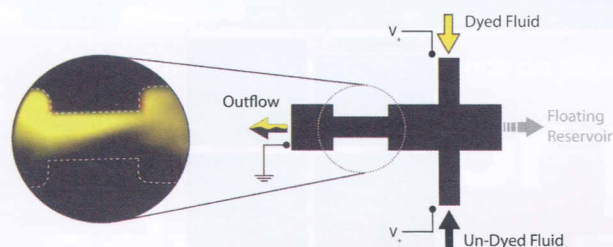
In situ characterization of microdroplet interfacial properties in digital microfluidic systems

Ali Ahmadi, Kurt D. Devlin, Homayoun Najjaran, Jonathan F. Holzman and Mina Hoorfar*

In this paper, two new submodules are added to a digital microfluidic system which characterize the microdroplet interfacial properties and dielectric properties.



1436

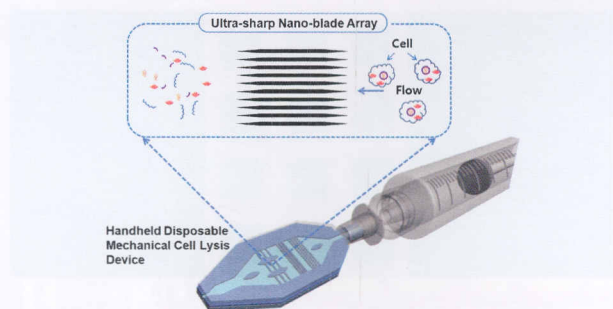


Abatement of mixing in shear-free elongationally unstable viscoelastic microflows

R. M. Bryce* and M. R. Freeman*

Adding polymer to fluids enables viscoelastic instabilities, yet reduces mixing relative to polymer-free fluids in shearless flows, indicating that additional deformations are required to promote mixing in unstable viscoelastic flows.

1442

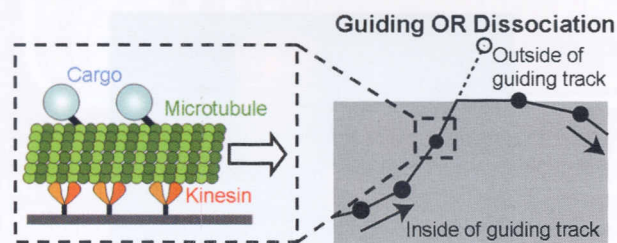


Handheld mechanical cell lysis chip with ultra-sharp silicon nano-blade arrays for rapid intracellular protein extraction

Sung-Sik Yun, Sang Youl Yoon, Min-Kyung Song, Sin-Hyeog Im, Sohee Kim, Jong-Hyun Lee and Sung Yang*

This paper presents a handheld mechanical cell lysis chip, capable of direct connection to a commercial syringe, prepared by simple and cost effective crystalline wet etching of (110) silicon.

1447

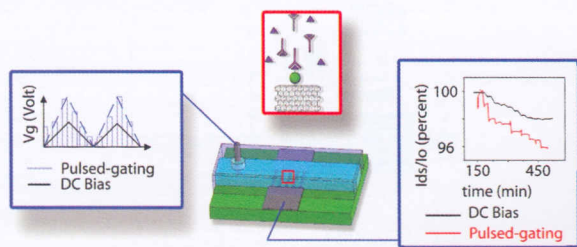


In silico design and testing of guiding tracks for molecular shuttles powered by kinesin motors

Takahiro Nitta,* Akihito Tanahashi and Motohisa Hirano

We present an extended computer simulation method which allows *in silico* design and testing of guiding tracks for molecular shuttles powered by kinesin motors. The simulation reproduced molecular shuttle movements under external forces, and dissociation of shuttles from guiding track surfaces.

1454



Investigation of sensing mechanism and signal amplification in carbon nanotube based microfluidic liquid-gated transistors via pulsating gate bias

I. Putu Mahendra Wijaya, Tey Ju Nie, Isabel Rodriguez and Subodh G. Mhaisalkar*

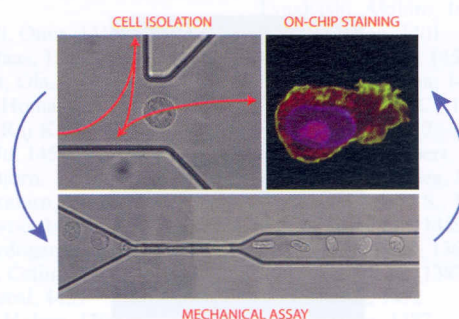
A pulsed-gating bias applied to a liquid gate carbon nanotube based transistor biosensor allowing a wider operating window beyond 1 V and pushing the detection limits down to the attomolar level.

1459

A simple microfluidic method to select, isolate, and manipulate single-cells in mechanical and biochemical assays

Sylvain Gabriele, Marie Versaevel, Pascal Preira and Olivier Théodoly*

This article describes a simple and low-tech microfluidic method for single-cell experimentation, which permits cell selection without stress, cell manipulation with fine control, and passive self-exclusion of all undesired super-micronic particles.



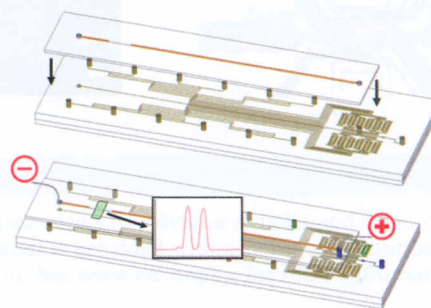
TECHNICAL NOTES

1468

Hybrid integrated PDMS microfluidics with a silica capillary

Ivan K. Dimov, Asif Riaz, Jens Duerée and Luke P. Lee*

We developed a novel module for effective hybrid integration of PDMS microfluidic devices and fused silica capillaries. These modules allow the direct application of a wide variety of well established conventional CE protocols for separations of complex analytes and the potential for facile coupling to ESI-MS.

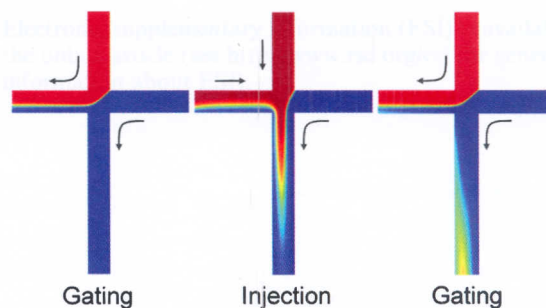


1472

Hydrodynamic gating for sample introduction on a microfluidic chip

Pu Chen, Xiaojun Feng, Jian Sun, Ying Wang, Wei Du and Bi-Feng Liu*

We present a microfluidic sample introduction approach based on hydrodynamic gated injection, which exhibits advantages of strong driving force and good biocompatibility, ideal for applications involving live biological samples.

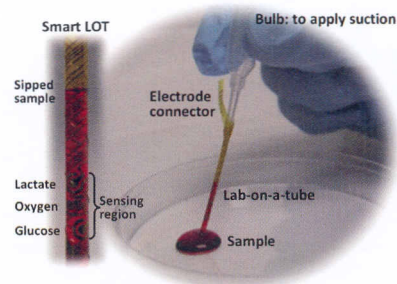


1476

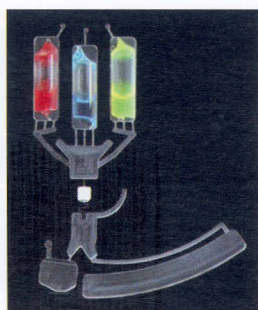
Potential of a simple lab-on-a-tube for point-of-care measurements of multiple analytes

Chunyan Li,* Lori A. Shutter, Pei-Ming Wu, Chong H. Ahn and Raj K. Narayan

This technical note presents a simple and disposable lab-on-a-tube (LOT) for point-of-care measurements of multiple analytes. It is a one-step device that can perform both sample collection and multi-sensing on-site.



1480

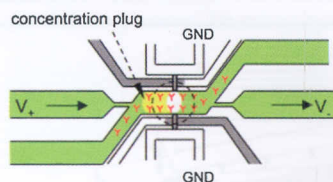


Pre-storage of liquid reagents in glass ampoules for DNA extraction on a fully integrated lab-on-a-chip cartridge

Jochen Hoffmann, Daniel Mark,* Sascha Lutz, Roland Zengerle and Felix von Stetten

We present an innovative approach for storage and release of liquid reagents in centrifugally operated LoaC cartridges. Applicability is demonstrated by a LoaC based DNA extraction featuring buffers which have been pre-stored for 140 days.

1485



Inset A



Capillary-valve-based fabrication of ion-selective membrane junction for electrokinetic sample preconcentration in PDMS chip

Vincent Liu, Yong-Ak Song and Jongyoon Han*

We are reporting a novel method for fabricating ion-selective membranes for use in electrokinetic sample preconcentrators, and demonstrating its efficacy in surface-based immunoassay with high ionic strength buffer solution.