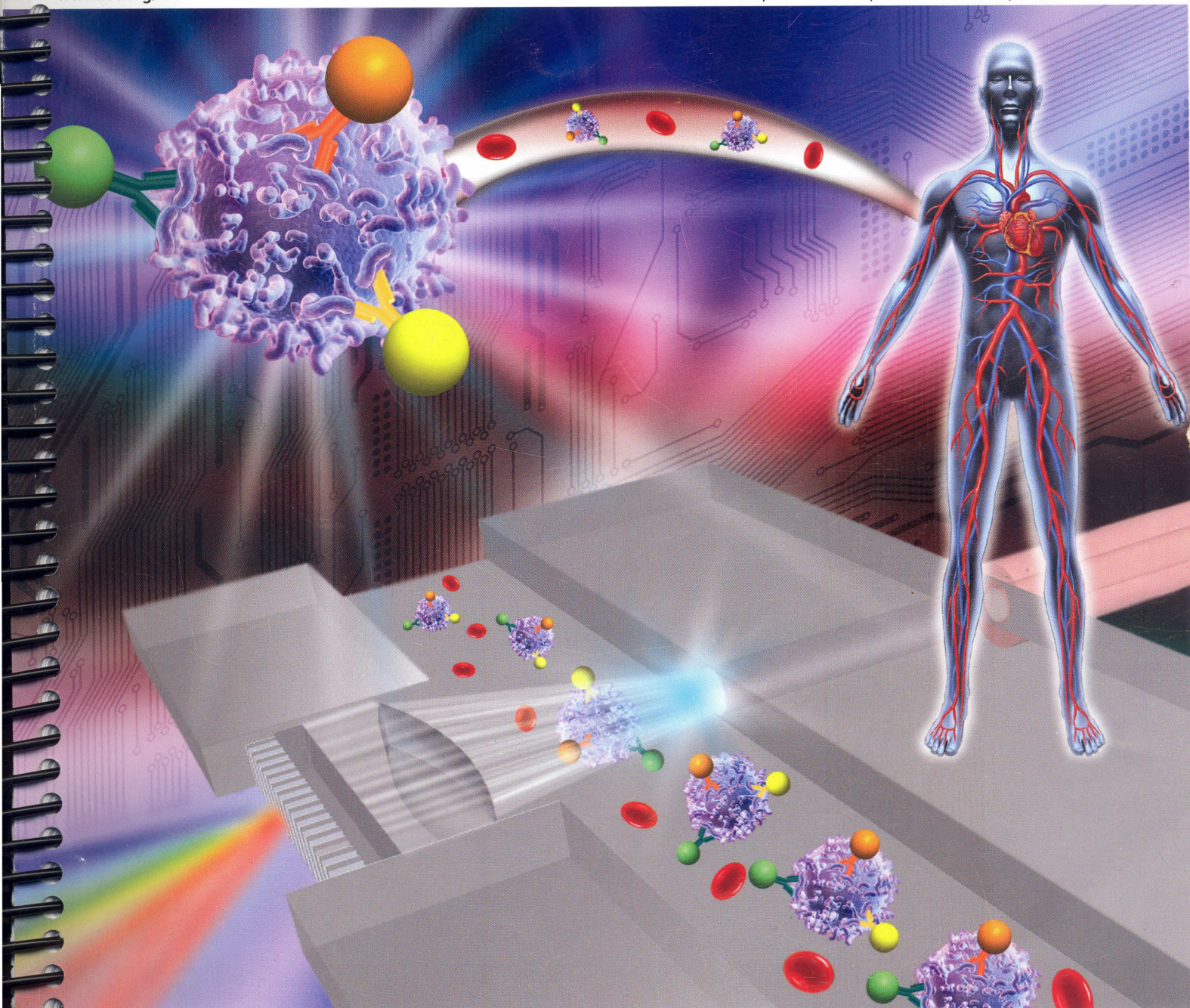


Lab on a Chip

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

www.rsc.org/loc

Volume 12 | Number 19 | 7 October 2012 | Pages 3523–3830



ISSN 1473-0197

RSC Publishing

CRITICAL REVIEW

Wenjun Zhang, Katsuo Kurabayashi *et al.*
Optofluidic detection for cellular phenotyping



1473-0197 (2012) 12:19;1-U

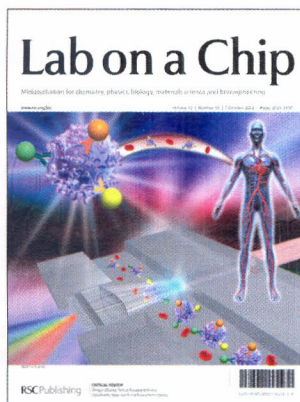
Lab on a Chip

Miniaturisation for chemistry, physics, biology, materials science and bioengineering
www.rsc.org/loc

RSC Publishing is a not-for-profit publisher and a division of the Royal Society of Chemistry. Any surplus made is used to support charitable activities aimed at advancing the chemical sciences. Full details are available from www.rsc.org

IN THIS ISSUE

ISSN 1473-0197 CODEN LCAHAM 12(19) 3523–3830 (2012)



Cover
See Wenjun Zhang, Katsuo Kurabayashi *et al.*, pp. 3552–3565. Image reproduced by permission of Wenjun Zhang from *Lab Chip*, 2012, 12, 3552.



Inside cover
See Ian B. Burgess *et al.*, pp. 3666–3669. Image reproduced by permission of Ian B. Burgess from *Lab Chip*, 2012, 12, 3666.

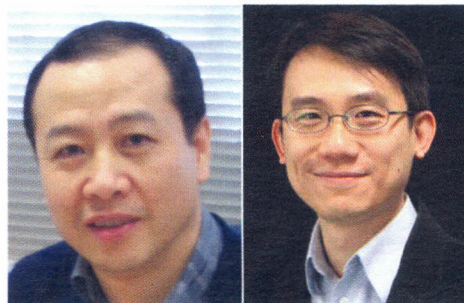
EDITORIAL

3539

Themed issue: Optofluidics

Ai-Qun Liu and Changhui Yang

Professors Ai-Qun Liu and Changhui Yang introduce this themed issue on optofluidics.



HIGHLIGHT

3540

Research highlights

Cole A. DeForest, Huaibin Zhang, Adnan Memic, Mehmet Dokmeci and Ali Khademhosseini*

Sugar-templated hydrogels for vascular tissue engineering – 3D culturing of captured circulating tumor cells – weaving hydrogels into mosaic art.

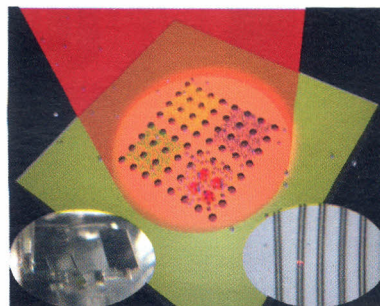


3543

Optofluidic devices and applications in photonics, sensing and imaging

Lin Pang,* H. Matthew Chen, Lindsay M. Freeman and Yeshaiahu Fainman*

This review describes the progress of optofluidics from a photonics perspective, highlighting various optofluidic aspects ranging from the device's property manipulation to an interactive integration between optics and fluids.



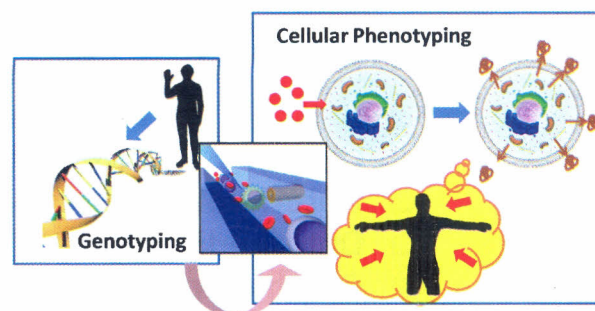
CRITICAL REVIEWS

3552

Optofluidic detection for cellular phenotyping

Yi-Chung Tung, Nien-Tsu Huang, Bo-Ram Oh, Bishnubrata Patra, Chi-Chun Pan, Teng Qiu, Paul K. Chu, Wenjun Zhang* and Katsuo Kurabayashi*

We review recent developments of optofluidic technology targeting cellular phenotyping studies in the current transition period from cellular genotyping to phenotyping.

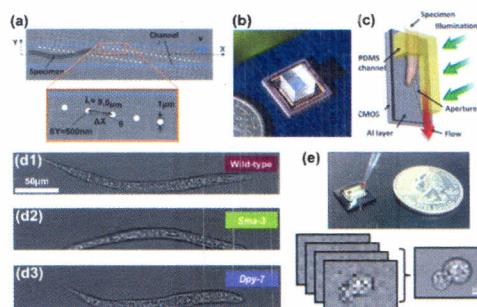


3566

Optical imaging techniques in microfluidics and their applications

Jigang Wu,* Guoan Zheng and Lap Man Lee

This review discusses optical imaging techniques that can be used in microfluidics with focus on compact systems.

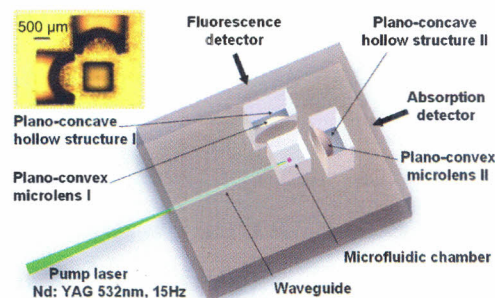


3576

Femtosecond laser processing for optofluidic fabrication

Koji Sugioka* and Ya Cheng*

This paper presents a comprehensive review of optofluidic devices for biological analysis fabricated by femtosecond laser processing.

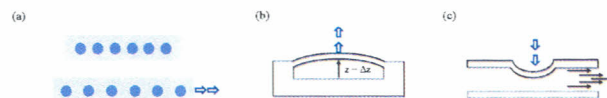


3590

Elastomer based tunable optofluidic devices

Wuzhou Song, Andreas E. Vasdekis and Demetri Psaltis

The synergetic integration of photonics and microfluidics has enabled a wide range of optofluidic devices that can be tuned based on various physical mechanisms.

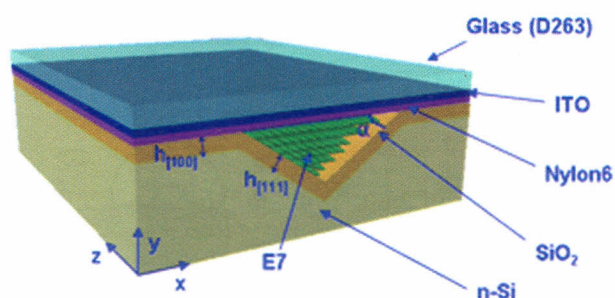


3598

Guided-wave liquid-crystal photonics

D. C. Zografopoulos,* R. Asquini, E. E. Kriezis, A. d'Alessandro and R. Beccherelli

We review the field of liquid-crystal tunable guided-wave photonic devices, spanning from micromachined liquid-crystals on silicon devices to periodic structures and liquid-crystal infiltrated photonic crystal fibers.

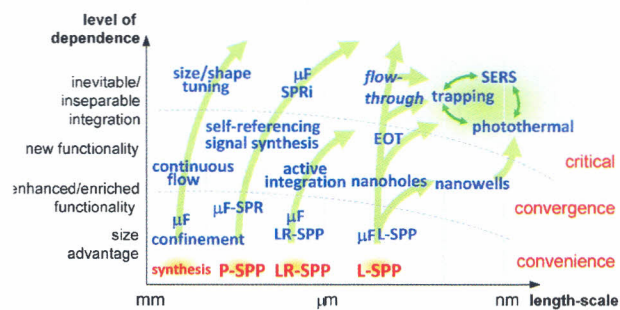


3611

Joining plasmonics with microfluidics: from convenience to inevitability

Jaeyoun Kim*

Recent progresses in the functional integration of plasmonics with micro/nano-fluidics have been surveyed using a categorization framework based on the level of their technical dependence.

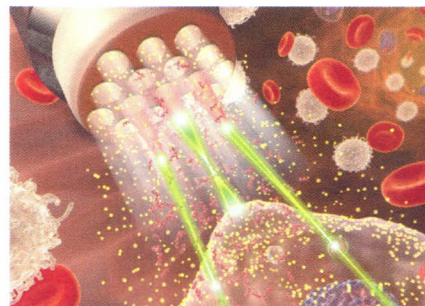


3624

Optically-actuated translational and rotational motion at the microscale for microfluidic manipulation and characterization

Samarendra Mohanty*

Schematic of a multifunctional fiber optical probe for trapping, force measurement, transport, stretching, two-photon excitation, and generation of microfluidic flow.



CRITICAL REVIEWS

3637

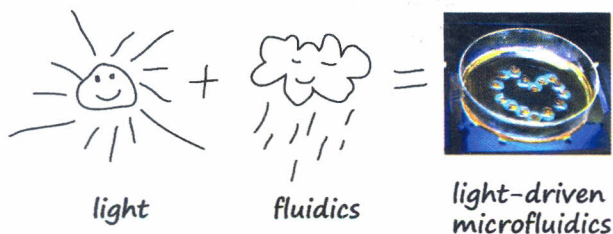


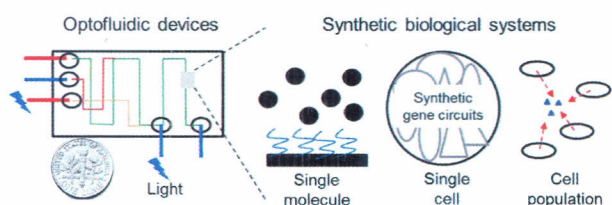
Photo-actuation of liquids for light-driven microfluidics: state of the art and perspectives

Damien Baigl

We provide the first comprehensive review on available strategies to induce and control micro-scale liquid motion using light.

FRONTIER

3654



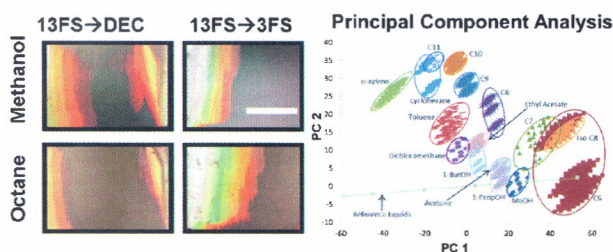
Frontiers of optofluidics in synthetic biology

Cheemeng Tan, Shih-Jie Lo, Philip R. LeDuc* and Chao-Min Cheng*

We propose several areas for potential applications of optofluidics in synthetic biology, which would have great potential for creating novel and useful biotechnologically-relevant applications in the future.

COMMUNICATIONS

3666

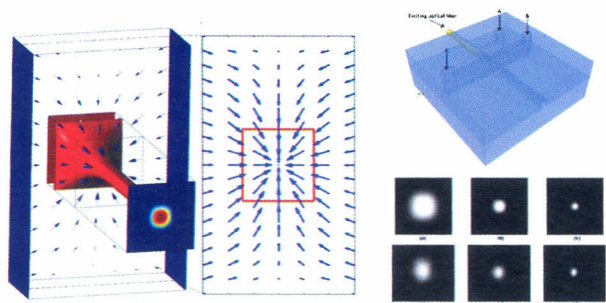


Combinatorial wetting in colour: an optofluidic nose

Kevin P. Raymond, Ian B. Burgess,* Mackenzie H. Kinney, Marko Lončar and Joanna Aizenberg

We present a colourimetric indicator based on wetting in photonic-crystal arrays, providing chemical specificity without sacrificing portability or ease-of-use.

3670



Integrated tunable liquid optical fiber

Genni Testa and Romeo Bernini*

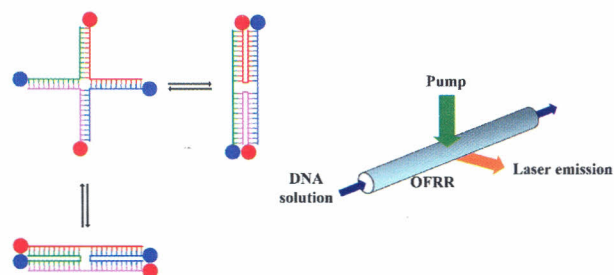
We present an integrated tunable liquid core-liquid cladding (L2) optical fiber based on a novel three-dimensional hydrodynamic focusing scheme that enables the production of a tunable circular liquid core located in the center of the channel regardless of the flow rate ratio of the cladding and core liquids.

3673

Bio-switchable optofluidic lasers based on DNA Holliday junctions

Xingwang Zhang, Wonsuk Lee and Xudong Fan*

A bio-switchable optofluidic laser based on DNA Holliday junctions achieves complete and reversible wavelength switching.

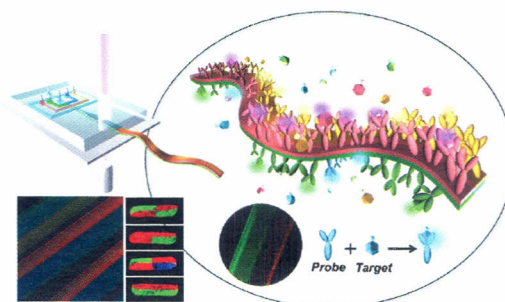


3676

High-throughput optofluidic platforms for mosaicked microfibers toward multiplex analysis of biomolecules

Soojeong Cho, Tae Soup Shim and Seung-Man Yang*

We describe high-throughput optofluidic platforms for stable production of microfibers with particular morphologies and compositional patterns by generating stratified laminar flows.



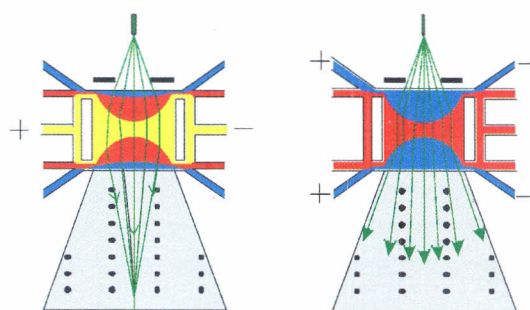
PAPERS

3680

An electrokinetically tunable optofluidic bi-concave lens

Haiwang Li, Chaolong Song, Trung Dung Luong, Nam-Trung Nguyen* and Teck Neng Wong

This paper numerically and experimentally investigates and demonstrates the design of an optofluidic in-plane bi-concave lens to perform both light focusing and diverging using the combined effect of pressure driven flow and electro-osmosis.

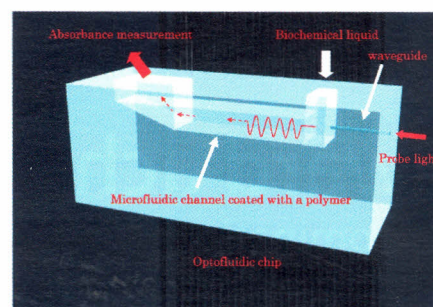


3688

Highly sensitive optofluidic chips for biochemical liquid assay fabricated by 3D femtosecond laser micromachining followed by polymer coating

Yasutaka Hanada, Koji Sugioka* and Katsumi Midorikawa

We present the fabrication of optofluidic chips integrated with a microfluidic channel whose internal walls are coated with a low refractive index polymer and an optical waveguide for biochemical liquid assay to perform highly sensitive concentration analysis of proteins and glucose-D.

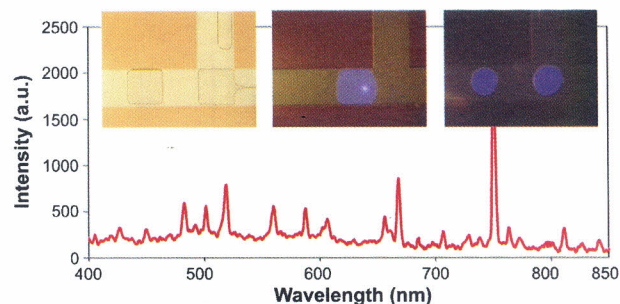


3694

Atmospheric-pressure microplasma in dielectrophoresis-driven bubbles for optical emission spectroscopy

Shih-Kang Fan,* Yan-Ting Shen, Ling-Pin Tsai, Cheng-Che Hsu, Fu-Hsiang Ko and Yu-Ting Cheng

Different gases are manipulated in 200 nL bubbles using dielectrophoresis and are excited to the plasma state for the optical emission spectroscopy.

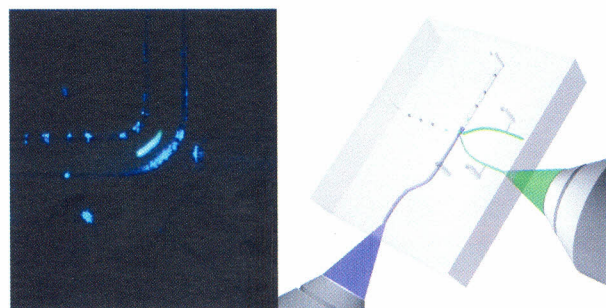


3700

A compact optofluidic cytometer with integrated liquid-core/PDMS-cladding waveguides

Peng Fei, Zitian Chen, Yongfan Men, Ang Li, Yiran Shen and Yanyi Huang*

Optofluidic devices can be simply created by forming optical waveguides *in situ* through filling microfluidic channels.

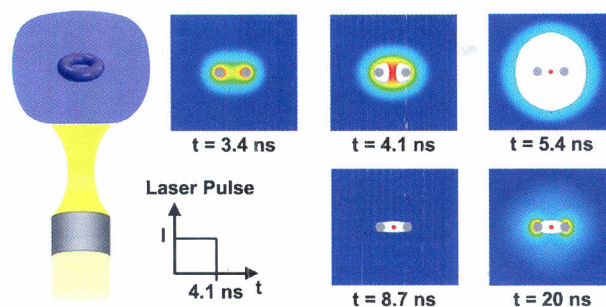


3707

Analysis of pulsed laser plasmon-assisted photothermal heating and bubble generation at the nanoscale

Edward P. Furlani,* Ioannis H. Karampelas and Qian Xie

Computational modeling of pulsed laser nanoparticle-based plasmon-assisted photothermal heating and nanobubble generation.

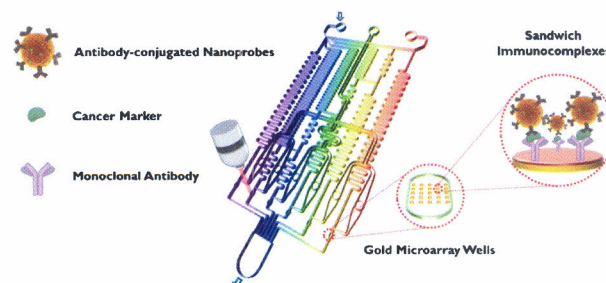


3720

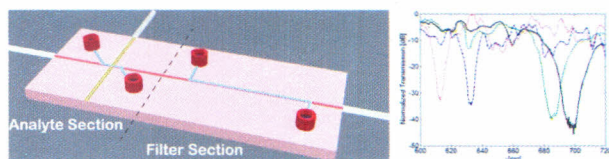
SERS-based immunoassay using a gold array-embedded gradient microfluidic chip

Moonkwon Lee, Kangsun Lee, Ki Hyung Kim, Kwang W. Oh* and Jaebum Choo*

We developed a conceptually new SERS-based immunoassay platform by integrating a gradient microfluidic device with gold-patterned microarray wells.



3728

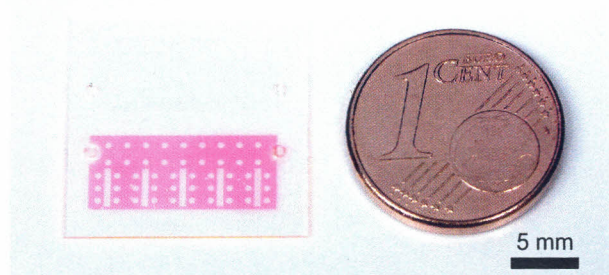


Dual-core optofluidic chip for independent particle detection and tunable spectral filtering

Damla Ozcelik, Brian S. Phillips, Joshua W. Parks, Philip Measor, David Gulbransen, Aaron R. Hawkins and Holger Schmidt*

Integration of fluidically tunable optofluidic notch and band-pass filters with a particle sensing section on a single liquid-core waveguide chip is demonstrated.

3734

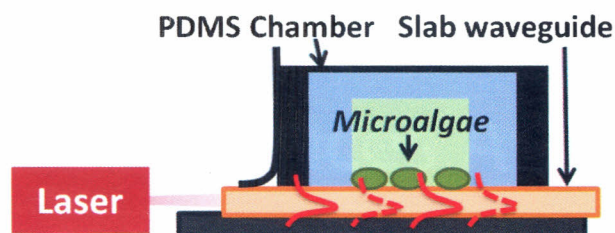


Diffusion driven optofluidic dye lasers encapsulated into polymer chips

Tobias Wienhold,* Felix Breithaupt, Christoph Vannahme, Mads Brøkner Christiansen, Willy Dörfler, Anders Kristensen and Timo Mappes*

We demonstrate the long term operation of diffusion driven optofluidic dye lasers with ultra-high output pulse energies and broad spectral tunability.

3740

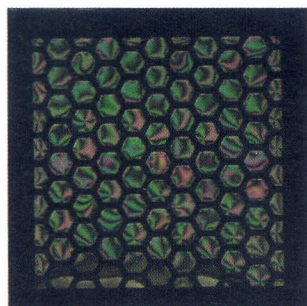


Slab waveguide photobioreactors for microalgae based biofuel production

Erica Eunjung Jung, Michael Kalontarov, Devin F. R. Doud, Matthew D. Ooms, Largus T. Angenent, David Sinton and David Erickson*

This paper describes novel slab waveguide photobioreactors for microalgae-based biofuel production.

3746



Microfluidic sensing devices employing *in situ*-formed liquid crystal thin film for detection of biochemical interactions

Ye Liu, Daming Cheng, I-Hsin Lin, Nicholas L. Abbott and Hongrui Jiang*

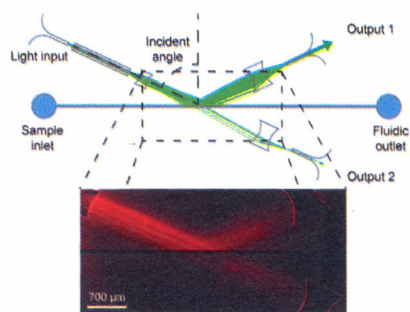
We demonstrate a highly reproducible method to generate high-quality liquid-crystal thin films *in situ* for biochemical sensing through aqueous laminar flows.

3754

Optofluidic micro-sensors for the determination of liquid concentrations

Emanuel Weber* and Michael J. Vellekoop

Non-invasive and label-free determination of liquid concentrations is demonstrated using an optofluidic device which exploits partial total internal reflection at the solid-liquid interface.

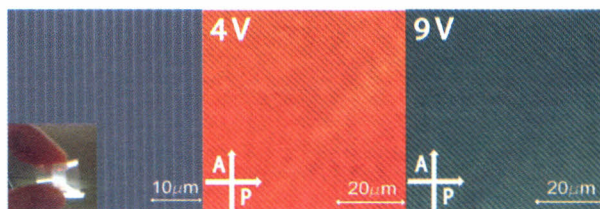


3760

Electro-switchable polydimethylsiloxane-based optofluidics

Luciano De Sio,* Marilisa Romito, Michele Giocondo, Andreas E. Vasdekis, Antonio De Luca and Cesare Umeton

Soft-conductive elastomeric microstructures combined with a smart anisotropic fluid enable realisation of switchable optofluidic colour filters.

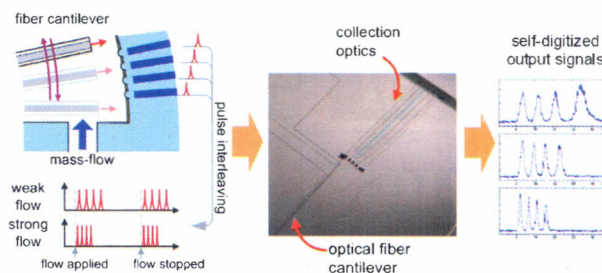


3766

A biomimetic mass-flow transducer utilizing all-optofluidic generation of self-digitized, pulse code-modulated optical pulse trains

Jiwon Lee, Jungwook Paek and Jaeyoun Kim*

Bio-inspired integration of microfluidic and optical functionalities has led to mass-flow transducers generating self-digitized and position-encoded outputs all-optofluidically, without using additional electronics.

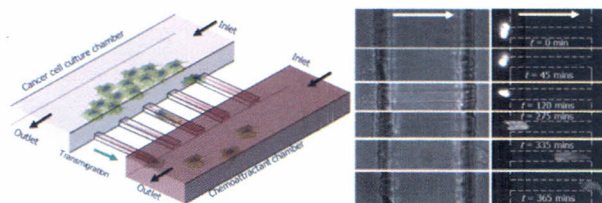


3774

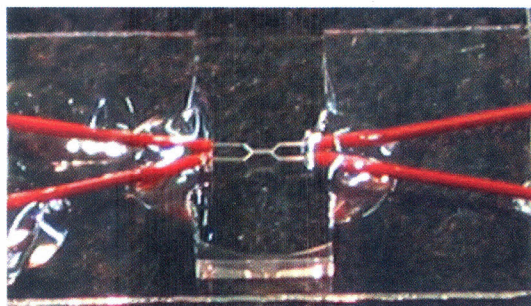
Nuclear deformation during breast cancer cell transmigration

Yi Fu, Lip Ket Chin, Tarik Bourouina, Ai Qin Liu and Antonius M. J. Van Dongen*

Nucleus deformation during the transmigration of breast cancer cells was studied using a microfluidic transmigration device.



3779

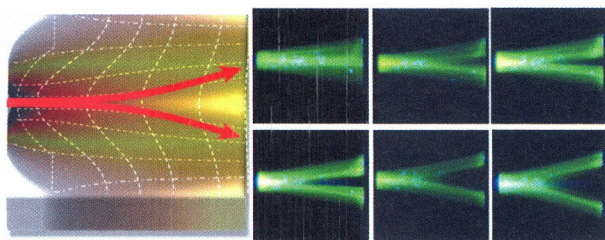


Optofluidic integrated cell sorter fabricated by femtosecond lasers

F. Bragheri, P. Minzioni, R. Martinez Vazquez, N. Bellini, P. Paiè, C. Mondello, R. Ramponi, I. Cristiani and R. Osellame*

Femtosecond-laser fabricated device allowing fluorescence detection and sorting of single cells by means of optical forces inside a microfluidic chip.

3785

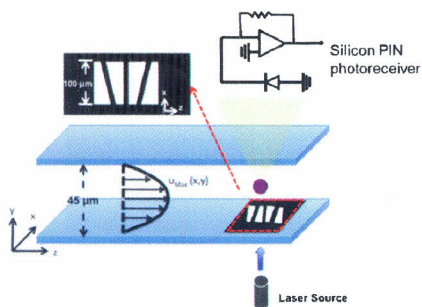


Transformation optofluidics for large-angle light bending and tuning

Y. Yang,* L. K. Chin, J. M. Tsai, D. P. Tsai, N. I. Zheludev and A. Q. Liu

Transformation optofluidics for large-angle light splitting by a spatially variable index.

3791

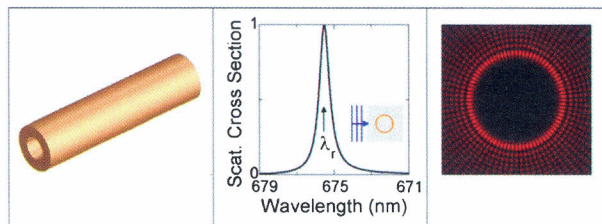


Optofluidic device for label-free cell classification from whole blood

Tsung-Feng Wu,* Zhe Mei and Yu-Hwa Lo

An optofluidic lab-on-a-chip device can optically encode forward scattering signals, providing the spatial information for cell identification by the size and stiffness of cells.

3798



Liquid sensing capability of rolled-up tubular optical microcavities: a theoretical study

Fangyuan Zhao, Tianrong Zhan, Gaoshan Huang, Yongfeng Mei* and Xinhua Hu*

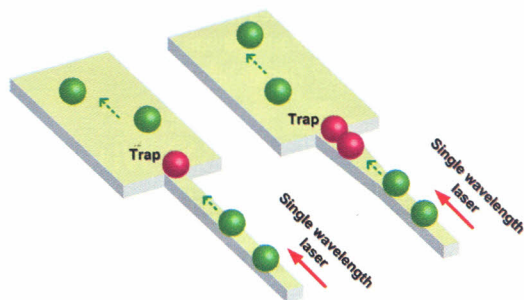
Rolled-up microtubes, which can contain liquids and support resonances with whispering gallery modes, have received much attention due to their applications in optofluidics.

3803

Optical trapping of microparticles using silicon nitride waveguide junctions and tapered-waveguide junctions on an optofluidic chip

Hong Cai and Andrew W. Poon*

This paper systematically studies planar optical tweezers for microparticle trapping using various designed waveguide junctions and tapered-waveguide junctions.



3810

Optofluidic variable-focus lenses for light manipulation

Y. C. Seow,* S. P. Lim and H. P. Lee

A planar liquid-core solid-cladding optofluidic biconvex lens achieves tunable optical diverging, collimating, and focusing. A lens-including fluorescence sensor is demonstrated.

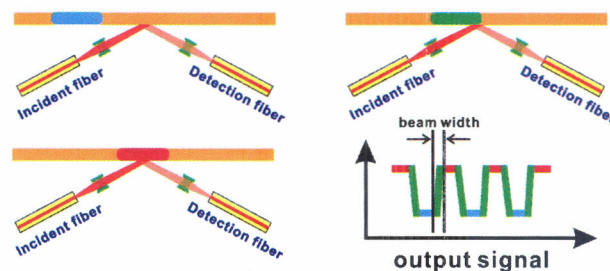


3816

Characterization of microdroplets using optofluidic signals

Zhenhua Shen, Yun Zou and Xianfeng Chen*

Determination of the droplet features in microfluidic channels by measuring the optical signals reflected at the PDMS–fluid interface.



3821

Hydrogel microrobots actuated by optically generated vapour bubbles

Wenqi Hu, Kelly S. Ishii, Qihui Fan and Aaron T. Ohta*

Hydrogel microrobots actuated by laser-induced bubbles were used to assemble microbeads, yeast cells, and cell-laden agarose microgels into various patterns.

