

# Lab on a Chip

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

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**PAPER**

van Steijn *et al.*

Monodisperse hydrogel microspheres by forced droplet formation in aqueous two-phase systems



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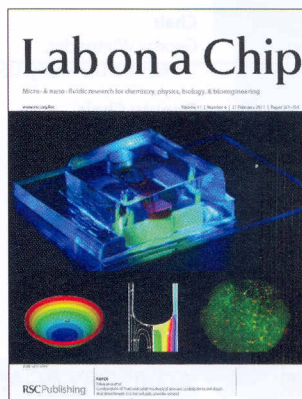
## IN THIS ISSUE

ISSN 1473-0197 CODEN LCAHAM 11(4) 557-760 (2011)



### Cover

See van Steijn *et al.*, pp. 620–624.  
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### Inside cover

See Takayama *et al.*, pp. 609–619.  
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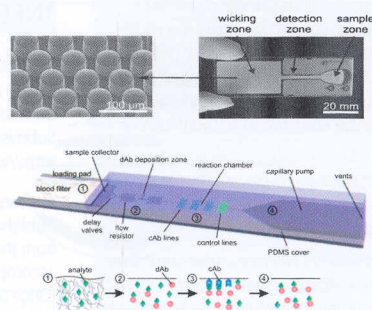
## TUTORIAL REVIEW

569

### Lab-on-a-chip based immunosensor principles and technologies for the detection of cardiac biomarkers: a review

Mazher-Iqbal Mohammed\* and Marc P. Y. Desmulliez

This review examines current commercial and research progress towards the development of lab-on-a-chip based cardiac biomarker detection systems, highlighting novel systems that enhance the portability and detection sensitivities in comparison to existing clinical standards and devices.



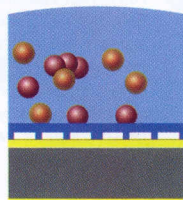
## COMMUNICATIONS

596

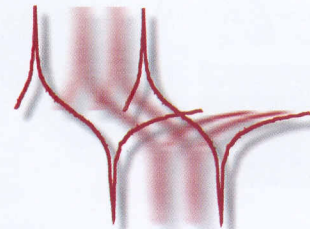
### Femtogram mass resolution in a liquid environment using a low loss vacuum-gapped quartz crystal resonator

Christopher Kirkendall and Jae Wan Kwon\*

Vacuum-gapped quartz crystal resonator enables high mass sensitivity and resolution in a liquid environment by isolating the liquid damping effect.



Quartz resonator with vacuum gap



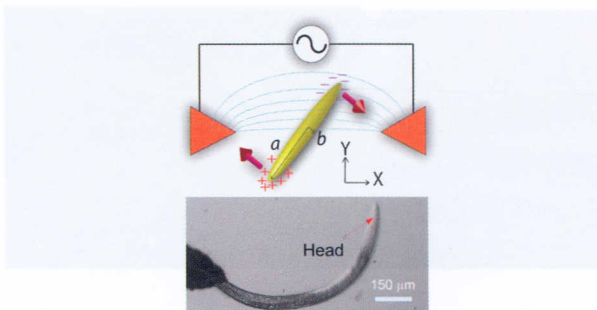
Frequency shift

599

### Dielectrophoresis of *Caenorhabditis elegans*

Han-Sheng Chuang, David M. Raizen, Annesia Lamb, Nooreen Dabbish and Haim H. Bau\*

This study demonstrates for the first time the dielectrophoretic trapping and manipulation of a whole animal, the nematode *Caenorhabditis elegans*. The effect of the electric field on the nematode as a function of field intensity and frequency was characterized.

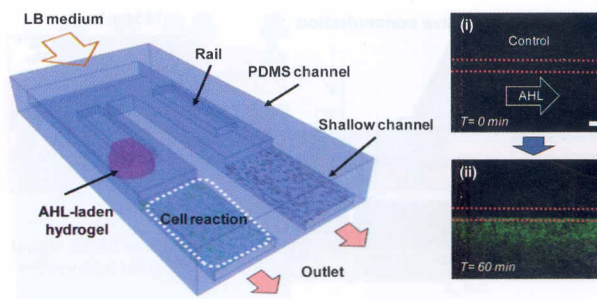


605

### Polymer based chemical delivery to multichannel capillary patterned cells

Sung Hoon Lee, Austen James Heinz, Sung-Eun Choi, Wook Park and Sunghoon Kwon\*

We demonstrate that UV polymerized hydrogel can be used as a miniature pipet to deliver picolitre chemical quantities to multichannel capillary patterned cells.



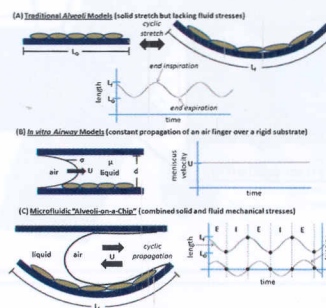
## PAPERS

609

### Combination of fluid and solid mechanical stresses contribute to cell death and detachment in a microfluidic alveolar model

Nicholas J. Douville, Parsa Zamankhan, Yi-Chung Tung, Ran Li, Benjamin L. Vaughan, Cheng-Feng Tai, Joshua White, Paul J. Christensen, James B. Grotberg\* and Shuichi Takayama\*

Studies using this micro-system demonstrated significant morphological differences between epithelial cells exposed to combination solid and fluid mechanical stresses compared to cell populations exposed solely to cyclic stretch (solid stresses).

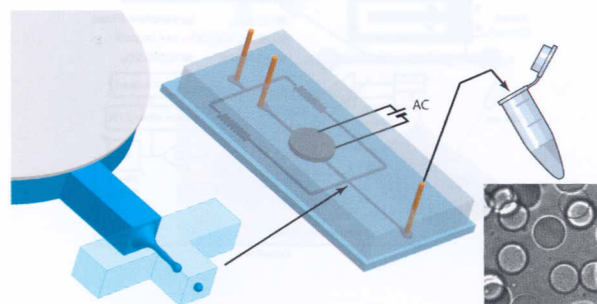


620

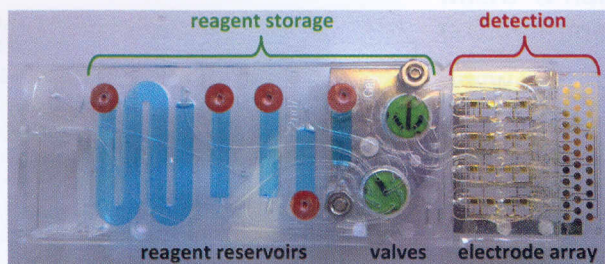
### Monodisperse hydrogel microspheres by forced droplet formation in aqueous two-phase systems

Iwona Ziemecka, Volkert van Steijn,\* Ger J. M. Koper, Michel Rosso, Aurelie M. Brizard, Jan H. van Esch and Michiel T. Kreutzer

We present a method to form water-in-water drops in an aqueous two-phase system and subsequently polymerize the drops to produce hydrogel beads.



625

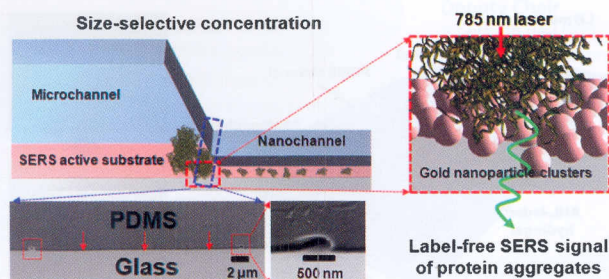


### Integrated microfluidic platform for the electrochemical detection of breast cancer markers in patient serum samples

Alex Fragoso,\* Daniel Latta, Noemi Laboria, Frithjof von Germar, Thomas E. Hansen-Hagge, Wolfgang Kemmer, Claudia Gärtner, Richard Klemm, Klaus S. Drese and Ciara K. O'Sullivan\*

A microfluidic platform integrating reagent storage and electrochemical detection has been applied in the detection of breast cancer markers in patient serum samples.

632

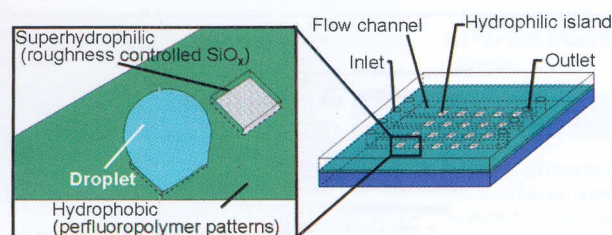


### Size-selective concentration and label-free characterization of protein aggregates using a Raman active nanofluidic device

Inhee Choi, Yun Suk Huh and David Erickson\*

We demonstrate an innovative label-free method for detecting and characterizing trace amounts of early stage protein aggregates. Nanofluidic channels formed by a novel elastomeric collapse technique enable the separation and concentration of matured protein aggregates. The Raman enhancement by gold nanoparticle clusters fixed below a micro/nanofluidic junction allows for characterizing intrinsic properties of protein aggregates.

639

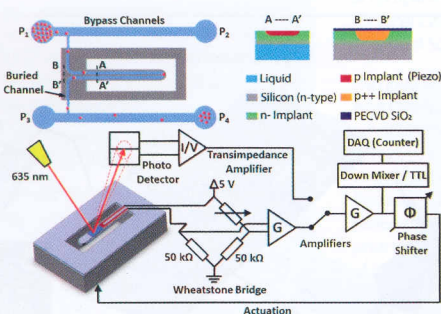


### Novel combination of hydrophilic/hydrophobic surface for large wettability difference and its application to liquid manipulation

Taizo Kobayashi, Kazunori Shimizu, Yoshihiro Kaizuma and Satoshi Konishi\*

A material combination for fabricating hydrophilic/hydrophobic patterns was investigated and their wettability difference was enhanced for droplet generation.

645



### Suspended microchannel resonators with piezoresistive sensors

J. Lee, R. Chunara, W. Shen, K. Payer, K. Babcock, T. P. Burg and S. R. Manalis\*

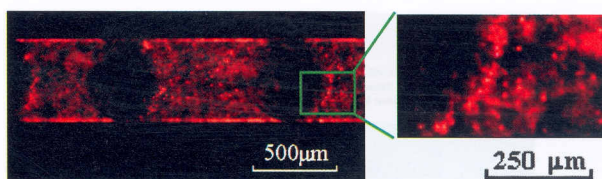
Suspended microchannel resonators with piezoresistive sensors have been developed to enable alignment free and portable mass sensing applications.

652

### Controllable preparation of nanoparticle-coated chitosan microspheres in a co-axial microfluidic device

Wenjie Lan, Shaowei Li, Jianhong Xu and Guangsheng Luo\*

In this work, we describe a simple microfluidic method for the *in situ* fabrication of nanoparticle-coated microspheres using recirculating flow in a microchannel.

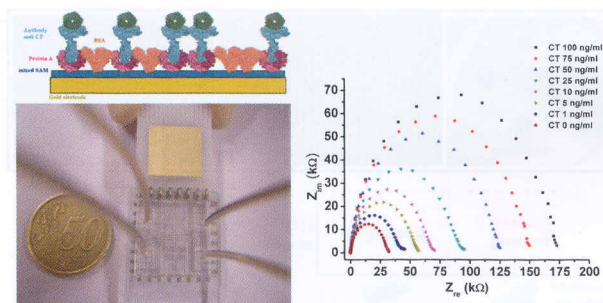


658

### EIS microfluidic chips for flow immunoassay and ultrasensitive cholera toxin detection

Maria Serena Chiriaco\*, Elisabetta Primiceri, Eliana D'Amone, Rodica Elena Ionescu, Ross Rinaldi and Giuseppe Maruccio\*

Flow injection impedimetric immunosensor for quick label-free detection of cholera toxin below 10 pM at low cost (about 3 € per unit).

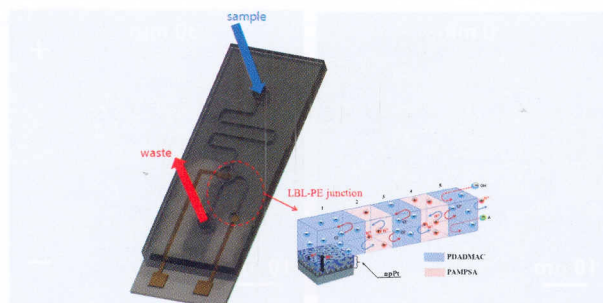


664

### Nanoporous platinum solid-state reference electrode with layer-by-layer polyelectrolyte junction for pH sensing chip

Jongmin Noh, Sejin Park, Hankil Boo, Hee Chan Kim\* and Taek Dong Chung\*

A novel solid-state reference electrode was developed by combining nanoporous Pt with polyelectrolyte junction.

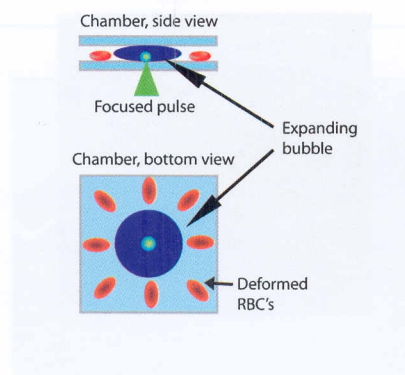


672

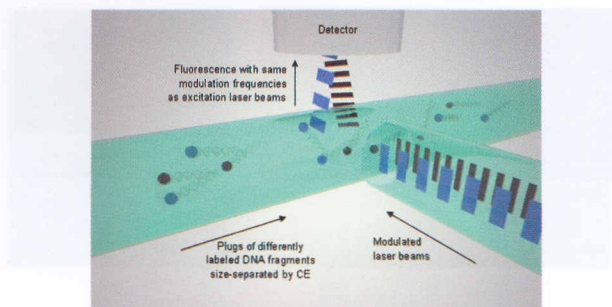
### Red blood cell rheology using single controlled laser-induced cavitation bubbles

Pedro A. Quinto-Su\*, Claudia Kuss, Peter R. Preiser and Claus-Dieter Ohl\*

A rapid rheology technique for the characterization of unmodified red blood cells using a transient flow.



679

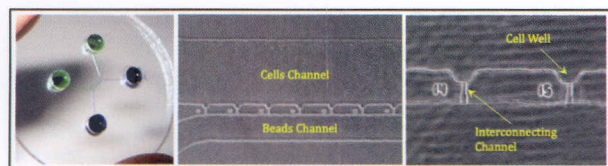


### Modulation-frequency encoded multi-color fluorescent DNA analysis in an optofluidic chip

Chaitanya Dongre, Jasper van Weerd, Geert A. J. Besselink, Rebeca Martinez Vazquez, Roberto Osellame, Giulio Cerullo, Rob van Weeghel, Hans H. van den Vlekkert, Hugo J. W. M. Hoekstra and Markus Pollnau\*

We introduce a principle of parallel optical processing to an optofluidic lab-on-a-chip. During electrophoretic separation, the ultra-low limit of detection achieved with our set-up allows us to record fluorescence from covalently end-labeled DNA molecules.

684

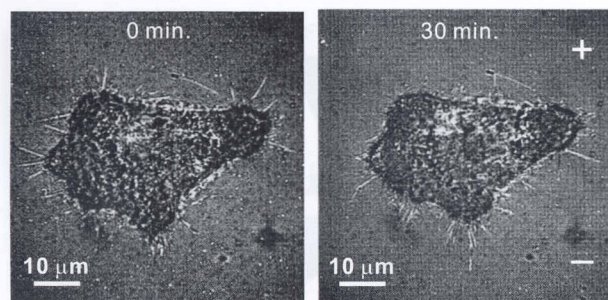


### A microfluidic system with optical laser tweezers to study mechanotransduction and focal adhesion recruitment

Peyman Honarmandi, Hyungsuk Lee, Matthew J. Lang and Roger D. Kamm\*

A new method is developed to locally apply mechanical force on single cells based on integration of a microfluidic device with an optical laser tweezers.

695

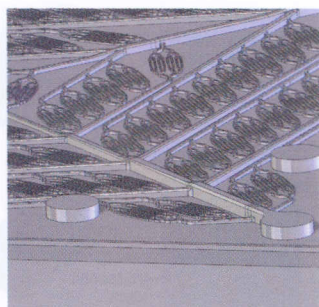


### Asymmetric cancer-cell filopodium growth induced by electric-fields in a microfluidic culture chip

Chun-Chieh Wang, Yu-Chiu Kao, Pei-Yin Chi, Ching-Wen Huang, Jiunn-Yuan Lin, Chia-Fu Chou, Ji-Yen Cheng\* and Chau-Hwang Lee\*

Filopodia of a human lung cancer cell respond to a  $180 \text{ mV mm}^{-1}$  direct current electric field in a micro cell culture chamber. After 30 min of electrical stimulation, the filopodia on the cathodal side have grown more than those on the anodal side.

700



### Lung assist device technology with physiologic blood flow developed on a tissue engineered scaffold platform

David M. Hoganson, Howard I. Pryor II, Erik K. Bassett, Ira D. Spool and Joseph P. Vacanti\*

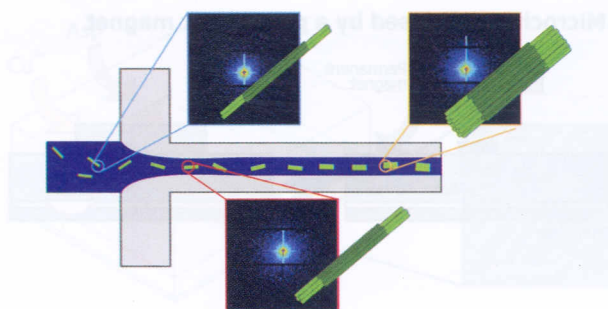
Physiologic 3D vascular network created with micromilling is the centerpiece of an efficient lung assist device technology.

708

### Dynamics of intermediate filament assembly followed in micro-flow by small angle X-ray scattering

Martha Elisabeth Brennich, Jens-Friedrich Nolting, Christian Dammann, Bernd Nöding, Susanne Bauch, Harald Herrmann, Thomas Pfohl and Sarah Köster\*

We present a study of self-assembly processes in intermediate filament proteins using a combined microfluidics and micro-focused SAXS approach.



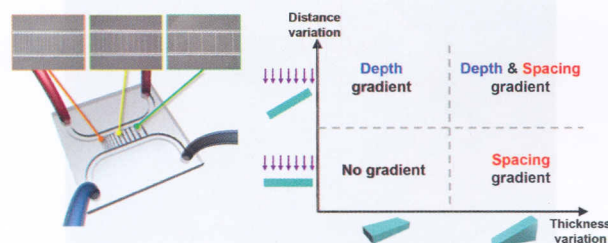
### TECHNICAL NOTES

717

### Controlled mechanical fracture for fabricating microchannels with various size gradients

Hong-Nam Kim, Sung-Hoon Lee and Kahp-Yang Suh\*

We present a simple method for fabricating microchannels with various size (depth, width, space) gradients by employing deep surface oxidation and anisotropic stretching.

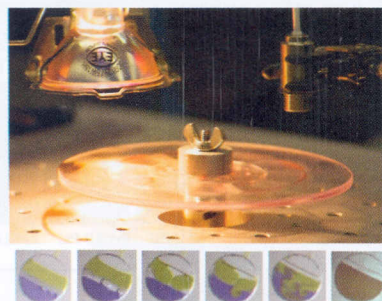


723

### Infrared controlled waxes for liquid handling and storage on a CD-microfluidic platform

Kameel Abi-Samra,\* Ryan Hanson, Marc Madou\* and Robert A. Gorkin III

Novel fluid handling and storage techniques for the centrifugal microfluidic disc platform based on non-contact actuation of paraffin wax plugs *via* infrared radiation.

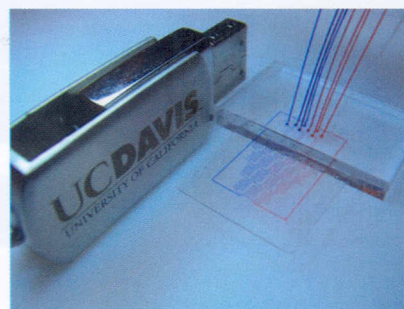


727

### Fit-to-Flow (F2F) interconnects: Universal reversible adhesive-free microfluidic adaptors for lab-on-a-chip systems

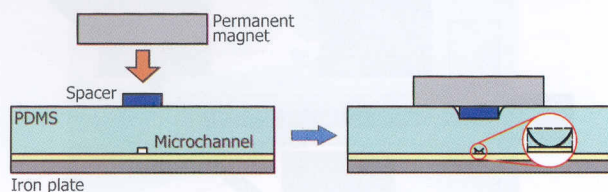
Arnold Chen and Tingrui Pan\*

Our standardized adhesive-free Fit-to-Flow (F2F) Interconnects, analogous to the modular plug-and-play USB architecture employed in modern electronics, utilize physical mechanisms to achieve reversible and integratable microfluidic packaging with high reliability.



733

**Microchannel closed by a permanent magnet**

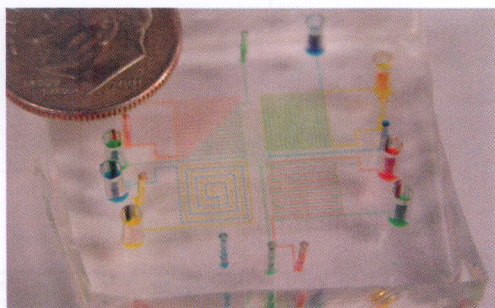


**Electrical isolation and characteristics of permanent magnet-actuated valves for PDMS microfluidics**

Chang-Yu Chen, Chang-Hung Chen, Ting-Yuan Tu, Cheng-Ming Lin and Andrew M. Wo\*

A simple yet useful magnetically driven valve utilizes a permanent magnet pressing a spacer against deformable PDMS to fully close a microchannel.

738

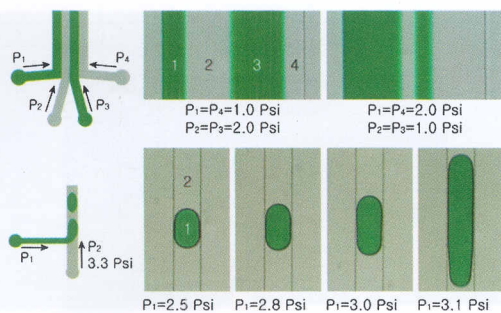


**High-density fabrication of normally closed microfluidic valves by patterned deactivation of oxidized polydimethylsiloxane**

Bobak Mosadegh, Hossein Tavana, Sasha Cai Leshner-Perez and Shuichi Takayama\*

High-density integration of normally closed elastomeric valves is demonstrated. A simple and efficient method for fabrication of normally closed valves is achieved by exploiting the transfer of polydimethylsiloxane oligomers during microcontact printing.

743

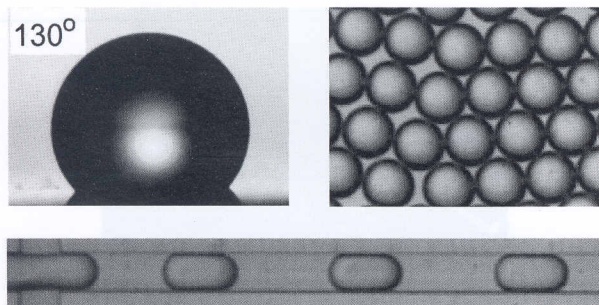


**Compressed-air flow control system**

Ki Wan Bong, Stephen C. Chapin, Daniel C. Pregibon, David Baah, Tamara M. Floyd-Smith and Patrick S. Doyle\*

We present the construction and operation of a compressed-air driven flow system that exhibits rapid dynamic response and allows for precise control of multiple inlet streams.

748



**Hydrophobic modification of polycarbonate for reproducible and stable formation of biocompatible microparticles**

Pawel Jankowski, Dominika Ogonczyk, Andrzej Kosinski, Wojciech Lisowski and Piotr Garstecki\*

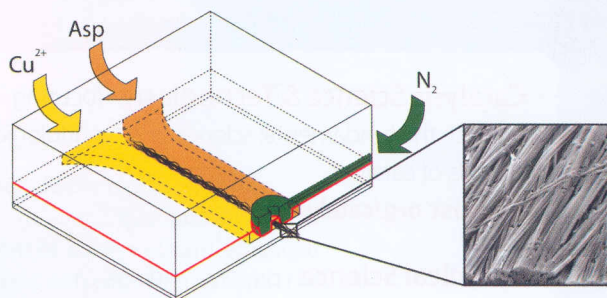
Modification of polycarbonate with dodecylamine prevents both static and dynamic wetting by aqueous solutions including viscous, non-Newtonian liquids and enables formation of particles of aqueous gels.



### Controlling the length and location of *in situ* formed nanowires by means of microfluidic tools

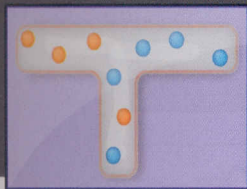
Phillip Kuhn, Josep Puigmartí-Luis, Inhar Imaz, Daniel Maspocho and Petra S. Dittrich\*

We have developed a multilayered microfluidic chip, which is capable of (i) dictating the assembly of 1D nanoscale metal-organic wires, (ii) fixating the position and length of the formed structures, and (iii) delivering chemical compound to trapped structures.



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Aaron Beeler, Professor, Boston University

Alexander O'Brien, Professor, Max-Planck-Institute of Colloids and Interfaces

Paul Watts, Senior Lecturer, University of Hull

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tel: +44 (0) 1787 315129 email: [a.woodley@selectbiosciences.com](mailto:a.woodley@selectbiosciences.com)



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