

# Lab on a Chip

Devices and applications at the micro- and nanoscale  
[rsc.li/loc](https://rsc.li/loc)

The Royal Society of Chemistry is the world's leading chemistry community. Through our high impact journals and publications we connect the world with the chemical sciences and invest the profits back into the chemistry community.

## IN THIS ISSUE

ISSN 1473-0197 CODEN LCAHAM 23(12) 2685–2868 (2023)



### Cover

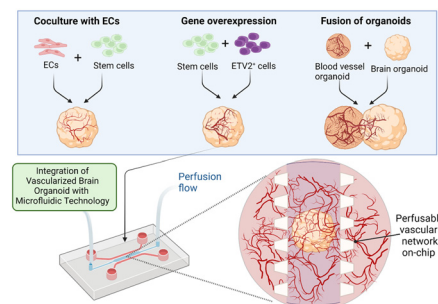
See Satoru Kuriu,  
Tadashi Ishida *et al.*,  
pp. 2729–2737.  
Image reproduced by  
permission of Tadashi Ishida  
from *Lab Chip*, 2023, 23, 2729.

## CRITICAL REVIEW

2693

### Vascularized human brain organoid on-chip

Sin Yen Tan, Xiaohan Feng, Lily Kwan Wai Cheng  
and Angela Ruohao Wu\*

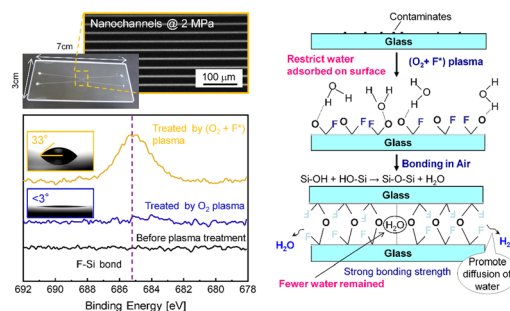


## COMMUNICATIONS

2710

### Room-temperature bonding of glass chips via PTFE-assisted plasma modification for nanofluidic applications

Qiushi Kang, Chenxi Wang,\* Kaimeng Liu  
and Takehiko Kitamori



## Editorial Staff

### Executive Editor

Philippa Ross

### Deputy Editor

Alice Smallwood

### Editorial Production Manager

Jason Woolford

### Development Editor

David Lake

### Publishing Editors

Gabriel Clarke, Derya Kara-Fisher,  
Emma Stephen, Ziva Whitelock

### Editorial Assistant

Leo Curtis

### Publishing Assistant

Andrea Whiteside

### Publisher

Jeanne Andres

For queries about submitted papers please contact  
Jason Woolford, Editorial Production Manager, in the first  
instance. E-mail: [loc@rsc.org](mailto:loc@rsc.org)

For pre-submission queries please contact Philippa Ross,  
Executive Editor.

E-mail: [loc-rsc@rsc.org](mailto:loc-rsc@rsc.org)

Lab on a Chip (electronic: ISSN 1473-0189) is published  
24 times a year by the Royal Society of Chemistry,  
Thomas Graham House, Science Park, Milton Road,  
Cambridge, UK CB4 0WF.

All orders, with cheques made payable to the Royal Society of  
Chemistry, should be sent to the Royal Society of Chemistry  
Order Department, Royal Society of Chemistry,  
Thomas Graham House, Science Park, Milton Road,  
Cambridge, CB4 0WF, UK  
Tel +44 (0)1223 432398; E-mail [orders@rsc.org](mailto:orders@rsc.org)  
2023 Annual (electronic) subscription price: £1617; US\$2902.  
Customers in Canada will be subject to a surcharge to cover  
GST. Customers in the EU subscribing to the electronic version  
only will be charged VAT.

If you take an institutional subscription to any Royal Society of  
Chemistry journal you are entitled to free, site-wide web access  
to that journal. You can arrange access via Internet Protocol  
(IP) address at [www.rsc.org/ip](http://www.rsc.org/ip)

Customers should make payments by cheque in sterling  
payable on a UK clearing bank or in US dollars payable  
on a US clearing bank.

Whilst this material has been produced with all due care, the  
Royal Society of Chemistry cannot be held responsible or liable  
for its accuracy and completeness, nor for any consequences  
arising from any errors or the use of the information contained  
in this publication. The publication of advertisements does not  
constitute any endorsement by the Royal Society of Chemistry  
or Authors of any products advertised. The views and opinions  
advanced by contributors do not necessarily reflect those of  
the Royal Society of Chemistry which shall not be liable for  
any resulting loss or damage arising as a result of reliance  
upon this material. The Royal Society of Chemistry is a charity,  
registered in England and Wales, Number 207890, and a  
company incorporated in England by Royal Charter (Registered  
No. RC000524), registered office:  
Burlington House, Piccadilly, London W1J 0BA, UK,  
Telephone: +44 (0) 207 4378 6556.

### Advertisement sales:

Tel +44 (0) 1223 432246; Fax +44 (0) 1223 426017;

E-mail [advertising@rsc.org](mailto:advertising@rsc.org)

For marketing opportunities relating to this journal,  
contact [marketing@rsc.org](mailto:marketing@rsc.org)

# Lab on a Chip

Devices and applications at the micro- and nanoscale

[rsc.li/loc](http://rsc.li/loc)

*Lab on a Chip* provides a unique forum for the publication of significant and original work related to miniaturisation, at the micro- and nano-scale, of interest to a multidisciplinary readership. The journal seeks to publish work at the interface between physical technological advancements and high impact applications that are of direct interest to a broad audience.

## Editorial board

### Editor-in-Chief

Aaron Wheeler, University of Toronto, Canada

### Associate Editors

Jean-Christophe Baret, University of

Bordeaux

Yoon-Kyoung Cho, UNIST, South Korea

Amy Herr, University of California, Berkeley,

USA

Séverine Le Gac, University of Twente,

The Netherlands

Hang Lu, Georgia Institute of Technology, USA

Xingyu Jiang, Southern University of Science

and Technology, Shenzhen, China

Manabu Tokeshi, Hokkaido University, Japan

Hongkai Wu, Hong Kong University of Science

and Technology, China

## Advisory Board

Esther Amstad, Swiss Federal Institute of

Technology in Lausanne (EPFL), Switzerland

Yoshinobu Baba, Nagoya University, Japan

Holger Becker, microfluidic ChipShop GmbH,

Germany

Anja Boisen, Technical University of Denmark,

Denmark

Oscar Ces, Imperial College London, UK

Dino Di Carlo, University of California, Los

Angeles, USA

Stephanie Descroix, Institut Curie, France

Petra Dittrich, ETH Zurich, Switzerland

Xudong Fan, University of Michigan, USA

Qun Fang, Zhejiang University, China

Albert Folch, University of Washington, USA

Piotr Garstecki, Institute of Physical Chemistry

of the Polish Academy of Sciences, Poland

Martin A. M. Gijls, EPFL, Switzerland

Mark Gilligan, Dolomite, UK

Keisuke Goda, University of Tokyo, Japan

Mei He, University of Kansas, USA

Tony Jun Huang, Duke University, USA

Yanyi Huang, Peking University, China

Daniel Irimia, Massachusetts General

Hospital, USA

David Issadore, University of Pennsylvania,

USA

Noo Li Jeon, Seoul National University, South

Korea

Michelle Khine, University of California,

Irvine, USA

Sunghoon Kwon, Seoul National University,

South Korea

Wlibur Lam, Georgia Institute of Technology

and Emory University, USA

Abraham Lee, University of California, Irvine,

USA

Gwo-Bin Lee, National Tsing Hua University,

Taiwan

Weihua Li, University of Wollongong, Australia

Xiujun Li, University of Texas at El Paso, USA

Chwee Teck Lim, National University of

Singapore, Singapore

Ai Qun Liu, The Hong Kong Polytechnic

University, China

Adrian Neild, Monash University, Australia

Australia

Nicole Pamme, Stockholm University, Sweden

Ian Papautsky, University of Illinois at Chicago,

USA

Jianhua Qin, Dalian Institute of Chemical

Physics, China

Sámuel Sánchez, Institute of Bioengineering of

Catalonia, Spain

Anderson Shum, University of Hong Kong,

China

David Sinton, University of Toronto, Canada

Shoji Takeuchi, University of Tokyo, Japan

Sindy Tang, Stanford University, USA

Yi-Chin Toh, Queensland University of

Technology, Australia

Albert van den Berg, University of Twente,

The Netherlands

Joel Voldman, Massachusetts Institute of

Technology, USA

Jeff Tza-Huei Wang, Johns Hopkins University,

USA

David Weitz, Harvard University, USA

George Whitesides, Harvard University, USA

Chaoyong James Yang, Xiamen University,

China

Po Ki Yuen, Corning Incorporated, New

York, USA

Roland Zengerle, Hahn-Schickard, Germany

Weian Zhao, University of California, Irvine,

USA

## Information for Authors

Full details on how to submit material for publication in Lab on a Chip are given in the Instructions for Authors (available from <http://www.rsc.org/authors>). Submissions should be made via the journal's homepage: [rsc.li/loc](http://rsc.li/loc)

Authors may reproduce/republish portions of their published contribution without seeking permission from the Royal Society of Chemistry, provided that any such republication is accompanied by an acknowledgement in the form: (Original Citation)–Reproduced by permission of the Royal Society of Chemistry.

This journal is © The Royal Society of Chemistry 2023.

Apart from fair dealing for the purposes of research or private study for non-commercial purposes, or criticism or review, as permitted under the Copyright, Designs and Patents Act 1988 and the Copyright and Related Rights Regulation 2003, this publication may only be reproduced, stored or transmitted, in any form or by any means, with the prior permission in writing of the Publishers or in the case of reprographic reproduction in accordance with the terms of licences issued by the Copyright Licensing Agency in the UK. US copyright law is applicable to users in the USA.

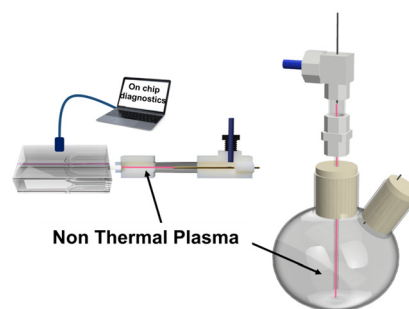
© The paper used in this publication meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

Registered charity number: 207890



## COMMUNICATIONS

2720

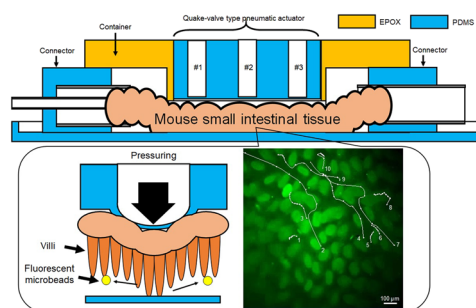
**Enabling batch and microfluidic non-thermal plasma chemistry: reactor design and testing**P. Roszkowska, A. Dickenson, J. E. Higham, T. L. Easun,\*  
J. L. Walsh\* and A. G. Slater\*

## PAPERS

2729

**Development of a microfluidic device to observe dynamic flow around the villi generated by deformation of small intestinal tissue**

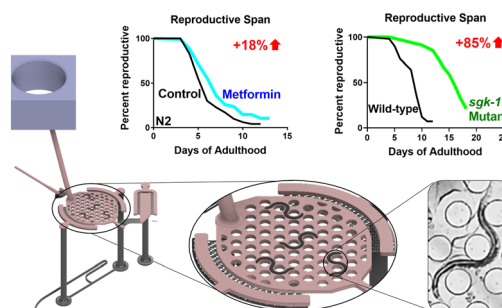
Satoru Kuriu,\* Naoyuki Yamamoto and Tadashi Ishida\*



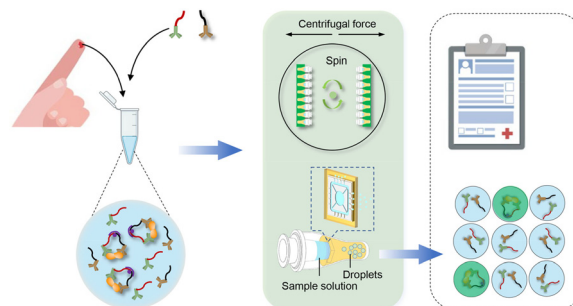
2738

**CeLab, a microfluidic platform for the study of life history traits, reveals metformin and SGK-1 regulation of longevity and reproductive span**

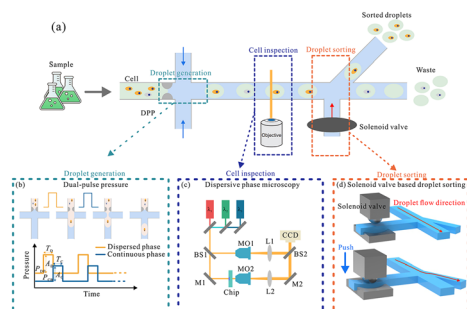
Salman Sohrabi, Vanessa Cota and Coleen T. Murphy\*



2758

**Highly parallel, wash-free, and ultrasensitive centrifugal droplet digital protein detection in sub-microliter blood**Zhengmin Tang, Feifei Lv, David Eun Reynolds,  
Shunji Zhang, Shufa Zheng, Jina Ko, Yu Chen\*  
and Yongcheng Wang\*

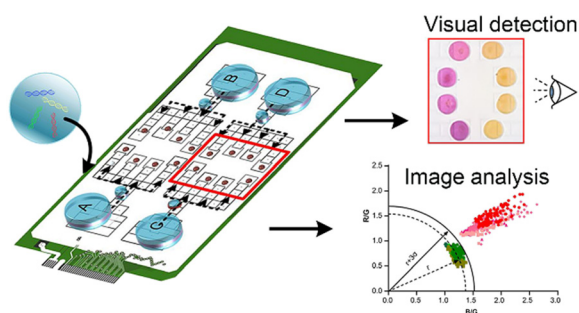
2766



### Dispersive phase microscopy incorporated with droplet-based microfluidics for biofactory-on-a-chip

Yingdong Luo, Yuanyuan Huang, Yani Li, Xiudong Duan, Yongguang Jiang, Cong Wang, Jiakun Fang,\* Lei Xi,\* Nam-Trung Nguyen and Chaolong Song\*

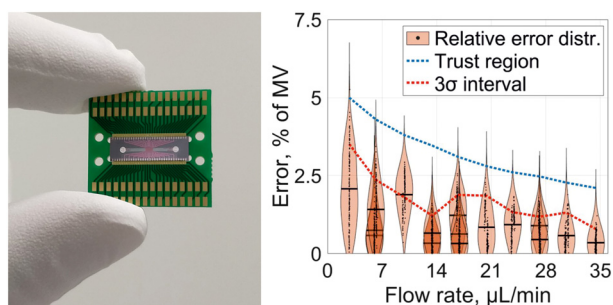
2778



### A digital microfluidic platform coupled with colorimetric loop-mediated isothermal amplification for on-site visual diagnosis of multiple diseases

Mei Xie, Tianlan Chen, Zongwei Cai, Bo Lei\* and Cheng Dong\*

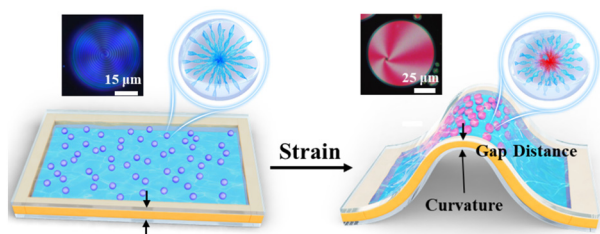
2789



### Integrated membrane-free thermal flow sensor for silicon-on-glass microfluidics

Vitaly V. Ryzhkov, Vladimir V. Echeistov, Aleksandr V. Zverev, Dmitry A. Baklykov, Tatyana Konstantinova, Evgeny S. Lotkov, Pavel G. Ryazantcev, Ruslan Sh. Alibekov, Aleksey K. Kuguk, Andrey R. Aleksandrov, Elisey S. Krasko, Anastasiya A. Barbasheva, Ilya A. Ryzhikov and Ilya A. Rodionov\*

2798



### Strain-induced recognition of molecular and chirality in cholesteric liquid crystal droplets for distance and curvature sensing

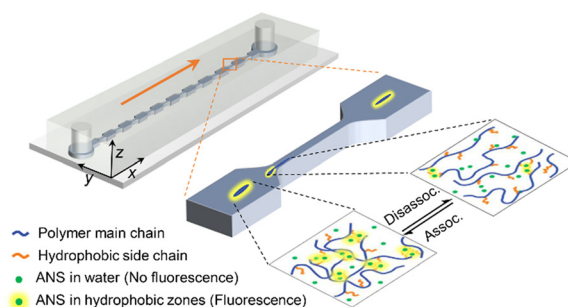
Shuting Xie, Ruizhi Yang, Qifan Zhu, Shitao Shen, Lanhui Li, Minmin Zhang, Xiaowen Hu, Mingliang Jin, Liqiu Wang\* and Lingling Shui\*



2808

## Rock-on-a-chip: “Seeing” the association/disassociation of an adaptive polymer in solutions flowing through porous media

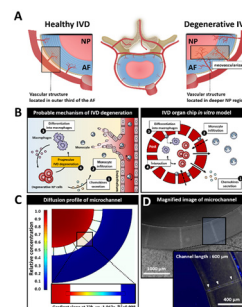
Yan Zhang, Xuezhi Zhao, Peihui Han, Tianlei He, Hongyao Yin, Liyuan Zhang,\* Yujun Feng\* and David A. Weitz\*



2819

## Intervertebral disc organ-on-a-chip: an innovative model to study monocyte extravasation during nucleus pulposus degeneration

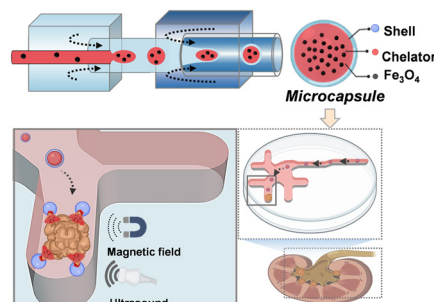
Hyeong-Guk Son, Min-Ho Hwang, Sumin Lee, An-Gi Kim, Tae-Won Kim, Joo-Han Kim, Hyuk Choi\* and Sehoon Jeong\*



2829

## Magnetic delivery and ultrasound-responsive release of chelating microcapsules for selective removal of urolithiasis

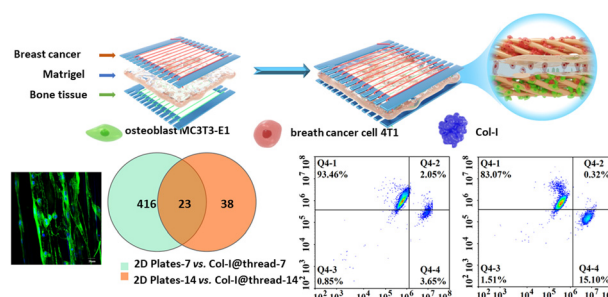
Byung Kwon Kaang, Sunjae Lee, JunJie Piao, Hyuk Jin Cho\* and Dong-Pyo Kim\*



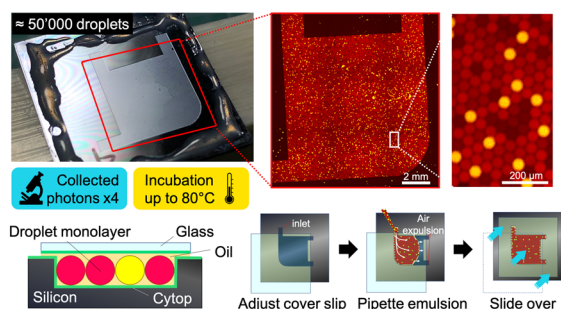
2838

## Probing the interaction between metastatic breast cancer cells and osteoblasts in a thread-based breast–bone co-culture device

Shi Ming Wu, Feng Chen, Xiao Yan Yang, Teng Fei Wu, Wei Sun and Ling Yu\*







## Silicon chambers for enhanced incubation and imaging of microfluidic droplets

Nicolas Lobato-Dauzier, Robin Deteix, Guillaume Gines, Alexandre Baccouche, Benediktus Nixon Hapsianto, Shu Okumura, Guilhem Mariette, Djaffar Belharet, Samuel Queste, Laurent Jalabert, Matthieu Denoual, Yannick Rondelez, Hiroshi Toshiyoshi, Hiroyuki Fujita, Soo Hyeon Kim, Teruo Fujii and Anthony J. Genot\*

