

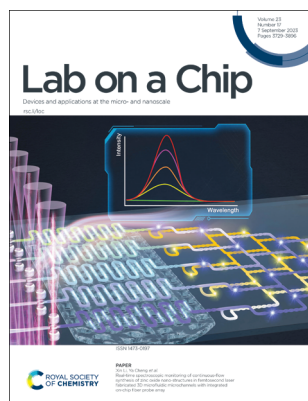
Lab on a Chip

Devices and applications at the micro- and nanoscale
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(17) 3729–3896 (2023)



Cover

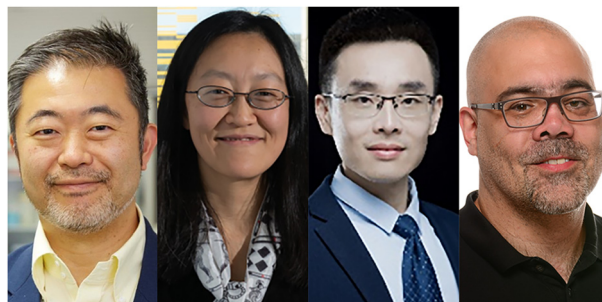
See Xin Li, Ya Cheng *et al.*,
pp. 3785–3793.
Image reproduced by
permission of Miao Wu, Xin Li
and Ya Cheng from *Lab Chip*,
2023, 23, 3785.

EDITORIAL

3737

Revolutionizing microfluidics with artificial intelligence: a new dawn for lab-on-a-chip technologies

Keisuke Goda,* Hang Lu, Peng Fei and Jochen Guck

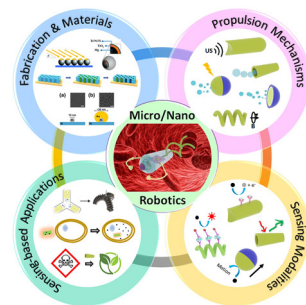


CRITICAL REVIEW

3741

Micro-/nanoscale robotics for chemical and biological sensing

Liuzheng Zheng, Nathan Hart and Yong Zeng*



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

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

E-mail: 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

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

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

For marketing opportunities relating to this journal,
contact marketing@rsc.org

Lab on a Chip

Devices and applications at the micro- and nanoscale

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. Gijb, 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

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

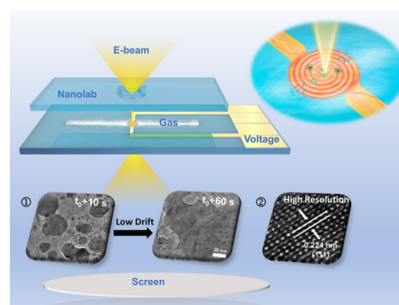


COMMUNICATIONS

3768

On-chip gas reaction nanolab for *in situ* TEM observation

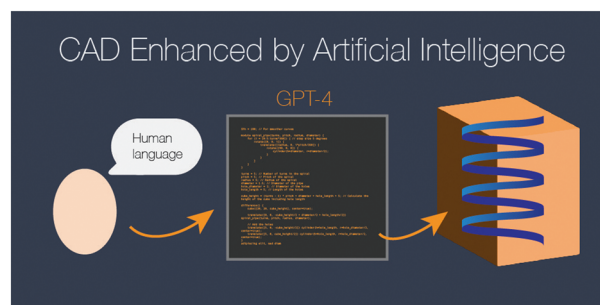
Tiqing Zhao, Youhong Jiang, Shiwen Luo, Yifan Ying, Qian Zhang, Shi Tang, Linzhi Chen, Jing Xia, Peng Xue, Jia-Jun Zhang, Shi-Gang Sun and Hong-Gang Liao*



3778

Utilizing ChatGPT to assist CAD design for microfluidic devices

Matt D. Nelson,* Brady L. Goenner and Bruce K. Gale

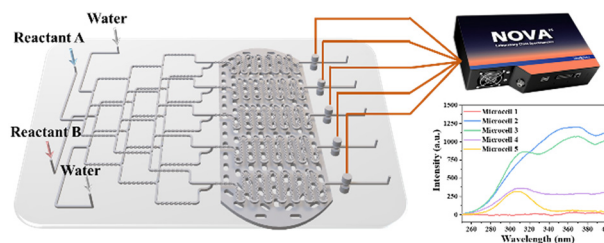


PAPERS

3785

Real-time spectroscopic monitoring of continuous-flow synthesis of zinc oxide nano-structures in femtosecond laser fabricated 3D microfluidic microchannels with integrated on-chip fiber probe array

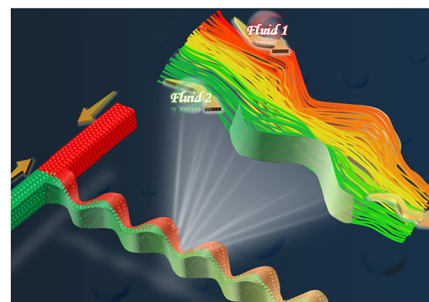
Miao Wu, Xin Li,* Di-Feng Yin, Wei Chen, Jia Qi, Ming Hu, Jian Xu and Ya Cheng*



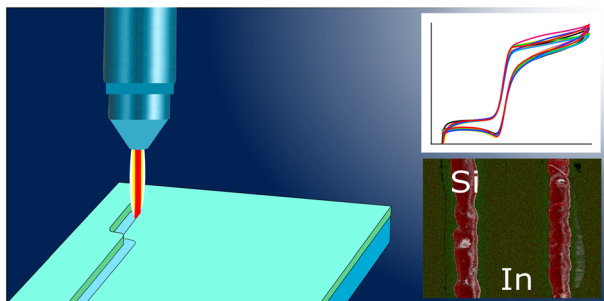
3794

Controlling amorphous silicon in scratching for fabricating high-performance micromixers

Tingting Chen, Licong Cui, Wang He, Renxing Liu, Chengqiang Feng, Lei Wu, Yang Wang, Huiyun Liu, Linmao Qian and Bingjun Yu*



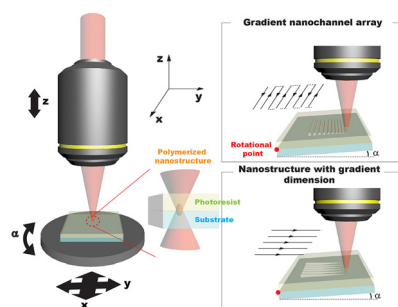
3802



Fabrication of ITO microelectrodes and electrode arrays using a low-cost CO₂ laser plotter

Karthika Kappalakandy Valapil, Marcin Szymon Filipiak, Weronika Rekiel, Elżbieta Jarosińska, Wojciech Nogala, Martin Jönsson-Niedziółka and Emilia Witkowska Nery*

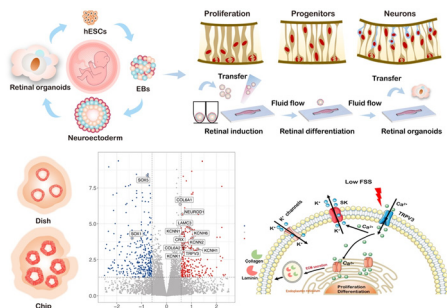
3811



An optically fabricated gradient nanochannel array to access the translocation dynamics of T4-phage DNA through nanoconfinement

Chen Zhang, Jiaqing Hou, Yang Zeng, Liang Dai, Wei Zhao, Guangyin Jing, Dan Sun, Yaoyu Cao* and Ce Zhang*

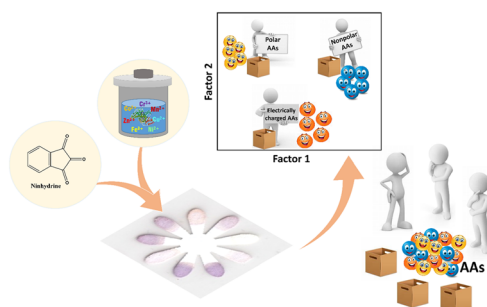
3820



A controllable perfusion microfluidic chip for facilitating the development of retinal ganglion cells in human retinal organoids

Jing Gong, Yu Gong, Ting Zou, Yuxiao Zeng, Cao Yang, Lingyue Mo, Jiahui Kang, Xiaotang Fan,* Haiwei Xu* and Jun Yang*

3837



A paper-based chemical tongue based on the charge transfer complex of ninhydrin with an array of metal-doped carbon dots discriminates natural amino acids and several of their enantiomers

Motahareh Alimohammadi, Hoda Sharifi, Javad Tashkhourian,* Mojtaba Shamsipur and Bahram Hemmateenejad*

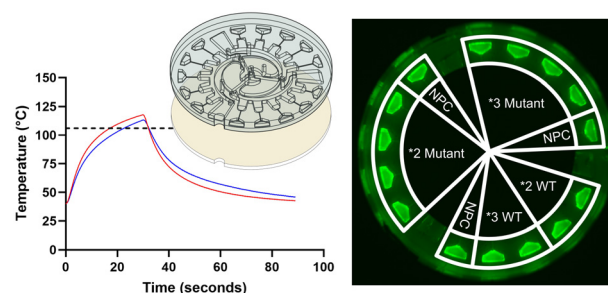


PAPERS

3850

Rapid microfluidics prototyping through variotherm desktop injection molding for multiplex diagnostics

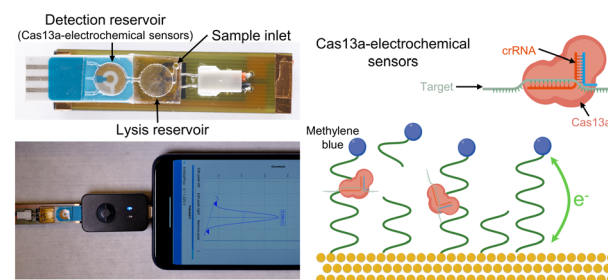
Gianmarco D. Suarez, Steevanson Bayer,
Yuki Yu Kiu Tang, Domenick A. Suarez,
Peter Pak-Hang Cheung* and Stefan Nagl*



3862

A point-of-care microfluidic biosensing system for rapid and ultrasensitive nucleic acid detection from clinical samples

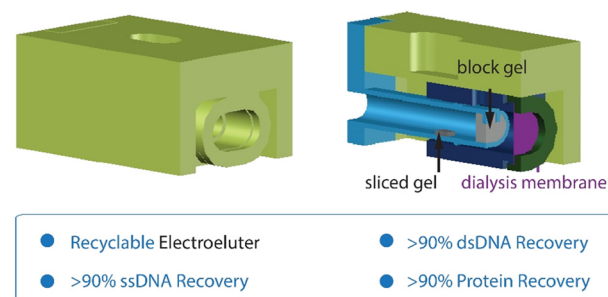
Yuxuan Zhang, Yang Song, Zhengyan Weng, Jie Yang,
Lori Avery, Kevin D. Dieckhaus, Rebecca Y. Lai, Xue Gao
and Yi Zhang*



3874

An efficient and recyclable electroeluter: from homemade to modular design for potential mass production

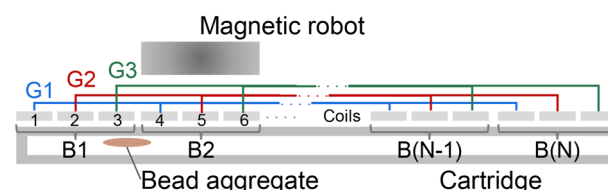
Linhan Su, Xueting Gong, Ju Zhou and Hailong Li*



3882

Programmable magnetic robot (ProMagBot) for automated nucleic acid extraction at the point of need

Anthony J. Politza, Tianyi Liu and Weihua Guan*



CORRECTION

3893

Correction: Metasurface-enhanced infrared spectroscopy in multiwell format for real-time assaying of live cells

Steven H. Huang,* Giovanni Sartorello, Po-Ting Shen, Chengqi Xu, Olivier Elemento* and Gennady Shvets*

