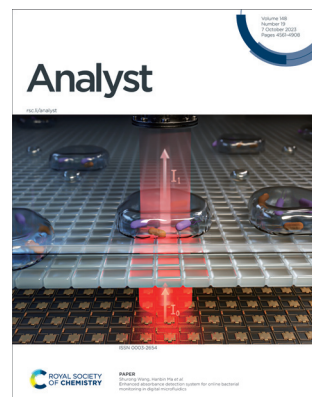


## IN THIS ISSUE

ISSN 0003-2654 CODEN ANALAO 148(19) 4561–4908 (2023)



### Cover

See Shurong Wang,  
Hanbin Ma *et al.*,  
pp. 4659–4667.

Image reproduced by  
permission of Hanbin Ma  
from *Analyst*, 2023, **148**,  
4659.



### Inside cover

See Robin Steudtner *et al.*,  
pp. 4668–4676.

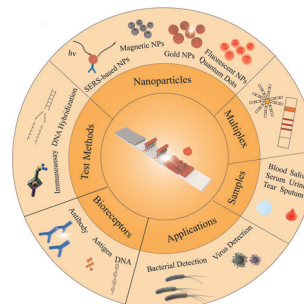
Image reproduced by  
permission of Max Klotzsche  
from *Analyst*, 2023, **148**,  
4668.

## CRITICAL REVIEWS

4573

### Lateral flow assay of pathogenic viruses and bacteria in healthcare

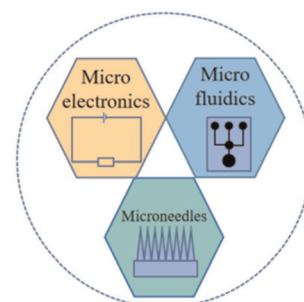
Xuanxu Nan, Xuesong Yao, Li Yang\* and Yue Cui\*



4591

### Modern microelectronics and microfluidics on microneedles

Yanzhang Han, Jun Li, Tingting Chen, Bingbing Gao\*  
and Huili Wang\*



## Editorial Staff

### Executive Editor

Rebecca Garton

### Deputy Editor

Alice Smallwood

### Editorial Production Manager

Sarah Whitehouse

### Development Editor

Celeste Brady

### Publishing Editors

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

### Publishing Assistant

Andrea Whiteside

### Editorial Assistant

Leo Curtis

### Publisher

Jeanne Andres

For queries about submitted articles please contact Sarah Whitehouse, Editorial production manager, in the first instance. E-mail [analyst@rsc.org](mailto:analyst@rsc.org)

For pre-submission queries please contact Rebecca Garton, Executive editor. E-mail [analyst-rsc@rsc.org](mailto:analyst-rsc@rsc.org)

Analyst (electronic: ISSN 1364-5528) 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: £2372; US\$4152. 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)

# Analyst

rsc.li/analyst

The home of premier fundamental discoveries, inventions and applications in the analytical and bioanalytical sciences

## Editorial Board

### Editor-in-Chief

Norman Dovichi, University of Notre Dame, USA

### Associate Editors

Damien Arrigan, Curtin University, Australia  
Ryan Bailey, University of Michigan, USA  
Jaebum Choo, Chung-Ang University, South Korea

Karen Faulds, University of Strathclyde, UK  
Hideaki Hisamoto, Osaka Metropolitan University, Japan

Baohong Liu, Fudan University, China  
Nicole Pamme, Stockholm University, Sweden

Hua-Zhong Yu, Simon Fraser University, Canada  
Jun-Jie Zhu, Nanjing University, China

### Members

Susan Lunte, University of Kansas, USA

## Advisory Board

Matthew Baker, University of Central Lancashire, UK  
Paul W Bohn, University of Notre Dame, USA  
Claudia Conti, CNR, Italy  
R Graham Cooks, Purdue University, USA  
Jeffrey Dick, Purdue University, USA  
Volker K. Deckert, University of Jena, Germany  
Joshua Edel, Imperial College London, UK  
Qun Fang, Zhejiang University, China  
Facundo Fernandez, Georgia Institute of Technology, USA  
Roy Goodacre, University of Liverpool, UK  
Duncan Graham, University of Strathclyde, UK  
Robert T Kennedy, University of Michigan, USA

USA  
Kagan Kerman, University of Toronto, Canada  
Christine Kranz, Ulm University, Germany  
Annamalai Senthil Kumar, Vellore Institute of Technology University, India  
Xiujun Li, University of Texas at El Paso, USA  
Lanqun Mao, Institute of Chemistry, Chinese Academy of Sciences, China  
Maria Marin, University of East Anglia, UK  
Pavel Matousek, Rutherford Appleton Laboratory, UK  
Wei Min, Columbia University, USA  
Boris Mizaikoff, University of Ulm, Germany  
Prakash Chandra Mondal, Indian Institute of Technology Kanpur, India

Howbeer Muhamadali, University of Liverpool, UK  
Takeaki Ozawa, University of Tokyo, Japan  
Ashley Ross, University of Cincinnati, USA  
Muhammad Shiddiky, Griffith University, Australia  
Debbie Silvester, Curtin University, Australia  
Steven A. Soper, University of Kansas, USA  
Dana Spence, Michigan State University, USA  
Nick Stone, University of Exeter, UK  
Evan Williams, University of California, USA  
Chaoyong James Yang, Xiamen University, China  
Yilun Ying, Nanjing University, China

## Information for Authors

Full details on how to submit material for publication in Analyst 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/analyst](http://rsc.li/analyst)

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

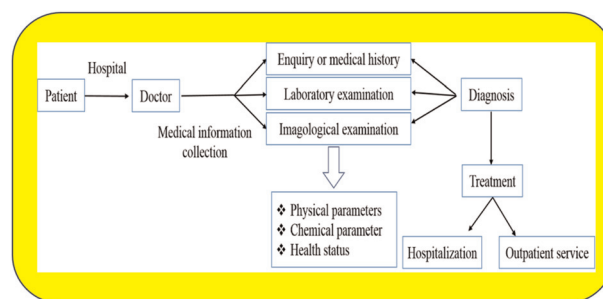


## CRITICAL REVIEWS

4616

**Wearable sensor platforms for real-time monitoring and early warning of metabolic disorders in humans**

Ravikumar Ayyanu, Amutha Arul, Ninghui Song, A. Anand Babu Christus, Xuesong Li, G. Tamilselvan, Yuanqing Bu,\* S. Kavitha, Zhen Zhang\* and Nan Liu\*

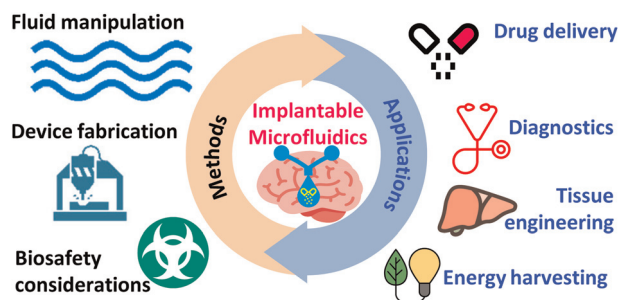


## TUTORIAL REVIEW

4637

**Implantable microfluidics: methods and applications**

Tao Luo,\* Lican Zheng, Dongyang Chen, Chen Zhang, Sirui Liu, Chongjie Jiang, Yu Xie, Dan Du and Wei Zhou

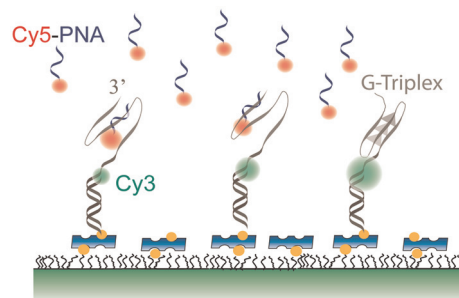


## COMMUNICATION

4655

**Detecting secondary structure formation with FRET-PAINT**

Sineth G. Kodikara, Kylie J. Merkel, Simon J. Haas, Sajad Shiekh and Hamza Balci\*

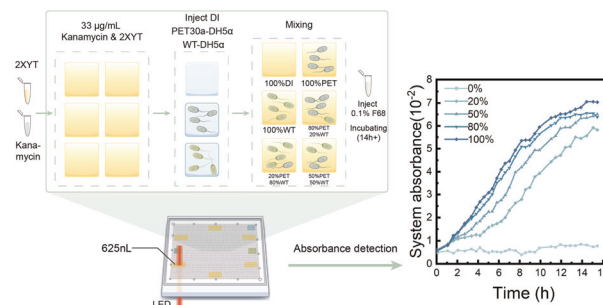


## PAPERS

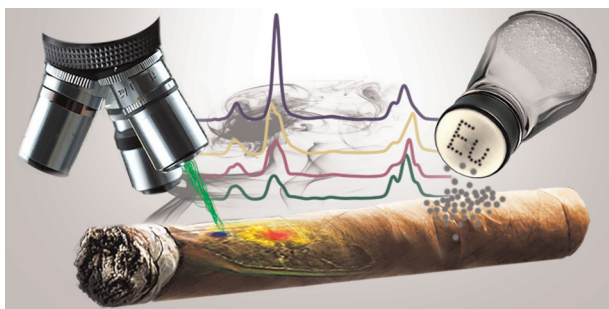
4659

**Enhanced absorbance detection system for online bacterial monitoring in digital microfluidics**

Jingya Wu, Maolin Zhang, Jianle Huang, Jingxin Guan, Chenxuan Hu, Mude Shi, Siyi Hu, Shurong Wang\* and Hanbin Ma\*



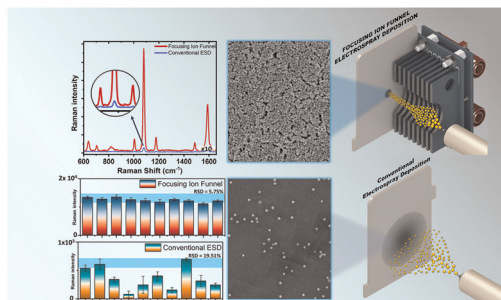
4668



### How tobacco (*Nicotiana tabacum*) BY-2 cells cope with Eu(III) – a microspectroscopic study

Max Klotzsche, Manja Vogel, Susanne Sachs, Johannes Raff, Thorsten Stumpf, Björn Drobot and Robin Steudtner\*

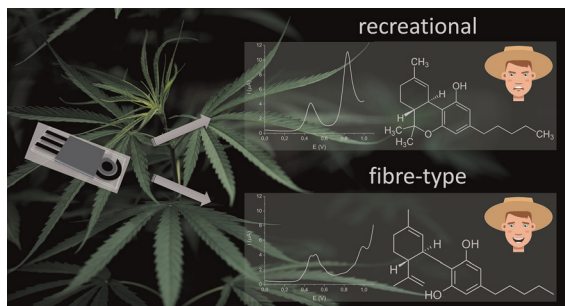
4677



### Focusing ion funnel-assisted ambient electrospray enables high-density and uniform deposition of non-spherical gold nanoparticles for highly sensitive surface-enhanced Raman scattering

Baris Akbali, Cedric Boisdon, Barry L. Smith, Boonphop Chaisrihwun, Kanet Wongravee, Tirayut Vilaivan, Cassio Lima, Chen-Han Huang, Tsan-Yao Chen, Royston Goodacre and Simon Maher\*

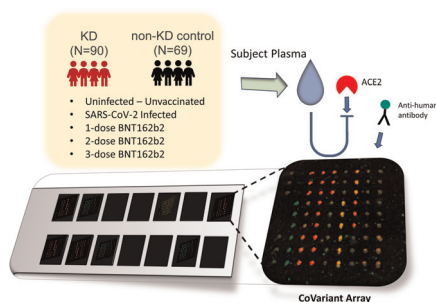
4688



### An electrochemical approach for the prediction of $\Delta^9$ -tetrahydrocannabinolic acid and total cannabinoid content in *Cannabis sativa* L.

Alessandro Monari, Sara Cantalù, Barbara Zanfognini, Virginia Brighenti, Patrizia Verri, Chiara Zanardi, Federica Pellati\* and Laura Pigani\*

4698



### Profiling humoral responses to COVID-19 immunization in Kawasaki disease using SARS-CoV-2 variant protein microarrays

Batuhan Birol Keskin, Shih-Feng Liu, Pin-Xian Du, Pei-Shan Tsai, Tzong-Shiann Ho, Wen-Yu Su, Pei-Chun Lin, Hsi-Chang Shih, Ken-Pen Weng, Kuender D. Yang, Ying-Hsien Huang, Kuang-Che Kuo, Guan-Da Syu\* and Ho-Chang Kuo\*

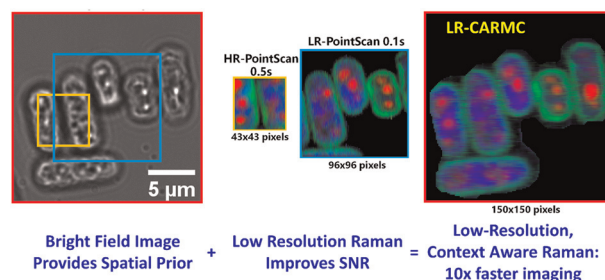


## PAPERS

4710

# Fast Raman imaging through the combination of context-aware matrix completion and low spectral resolution

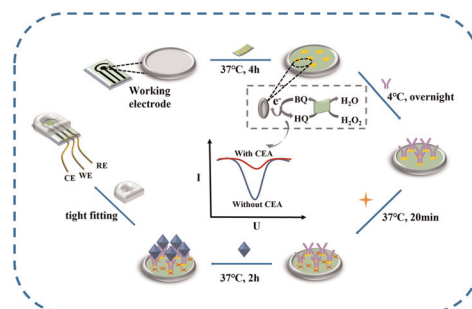
Ziling Jiang, Xianli Wang, Kaiqin Chu and Zachary J. Smith\*



4721

# A bimetallic metal–organic framework with high enzyme-mimicking activity for an integrated electrochemical immunoassay of carcinoembryonic antigen

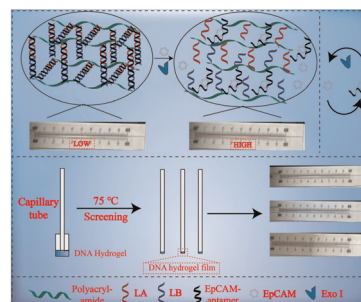
Yun Shu,\* Lu Yan, Mingli Ye, Long Chen, Qin Xu and Xiaoya Hu\*



4730

# Exo I signal amplification of a DNA hydrogel film combined with capillary self-driven action for EpCAM detection

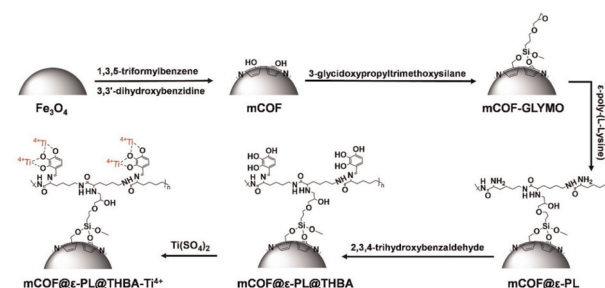
Shuang Li, Zhiguang Wang, Xiaoxiao Lin, Yalan Bian and Liqun Chen\*



4738

# Post-synthesis of a titanium-rich magnetic COF nanocomposite with flexible branched polymers for efficient enrichment of phosphopeptides from human saliva and serum

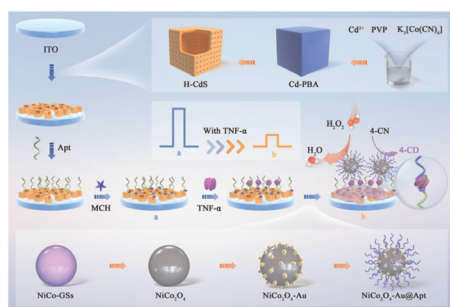
Luyan Meng, Bing Wang, Baichun Wang, Quanshou Feng, Sijia Zhang, Zi Xiong, Shun Zhang,\* Ting Cai, Chuan-Fan Ding\* and Yinghua Yan\*





## PAPERS

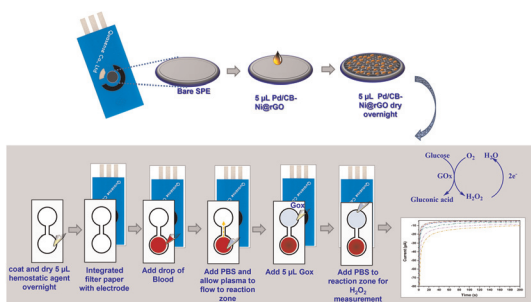
4746



### An ultrasensitive photoelectrochemical assay for tumor necrosis factor- $\alpha$ based on hollow CdS cubes as a signal generator and $\text{NiCo}_2\text{O}_4$ -Au as a signal extinguisher

Yamin Fu,\* Baohuan Fan, Shenzhen Chang, Dongyu Guo,\* Fuxiang Wang and Qinhe Pan\*

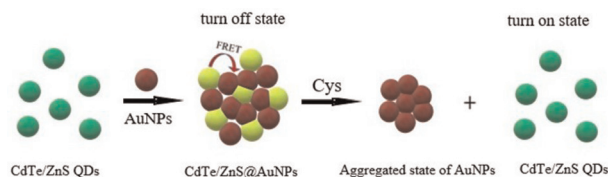
4753



### A sensitive and facile electrochemical paper-based sensor for glucose detection in whole blood using the Pd/CB-Ni@GO modified electrode

Chim Math, Kamolwich Income, Kawin Khachornsakul, Paweenar Duenchay and Wijitar Dungchai\*

4762



### An off-on fluorescent nanoprobe for L-cysteine sensing based on the FRET effect

Cai Shi, Yiming Zhao, Ruqian Xu and Yujie Ding\*

4768



### Fabrication and characterization of multi-biomarker optimized tissue-mimicking phantoms for multi-modal optical spectroscopy

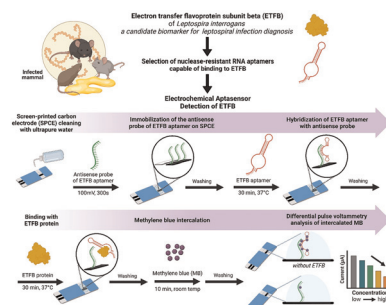
Rekha Gautam,\* Danielle Mac Mahon, Gráinne Eager, Hui Ma, Claudia Nunzia Guadagno, Stefan Andersson-Engels and Sanathana Konugolu Venkata Sekar



4777

## Electrochemical aptasensor detection of electron transfer flavoprotein subunit beta for leptospirosis diagnosis

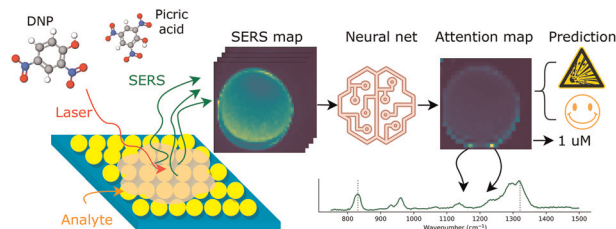
Uraivan Kositanont, Chatchawan Srisawat, Sirinapa Sripinitchai, Charin Thawornkuno, Thanyarat Chaibun, Sinthu Karunaitas, Chamras Promptmas and Benchaporn Lertanantawong\*



4787

## Nitroaromatic explosives' detection and quantification using an attention-based transformer on surface-enhanced Raman spectroscopy maps

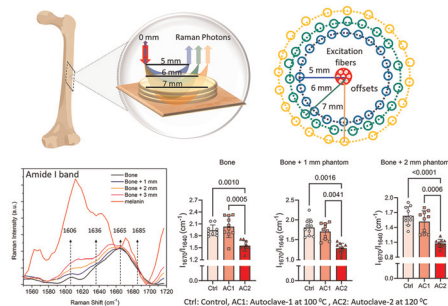
Bo Li,\* Giulia Zappalá, Elodie Dumont, Anja Boisen, Tomas Rindzevicius, Mikkel N. Schmidt and Tommy S. Alstrøm



4799

## Sensitivity of the amide I band to matrix manipulation in bone: a Raman micro-spectroscopy and spatially offset Raman spectroscopy study

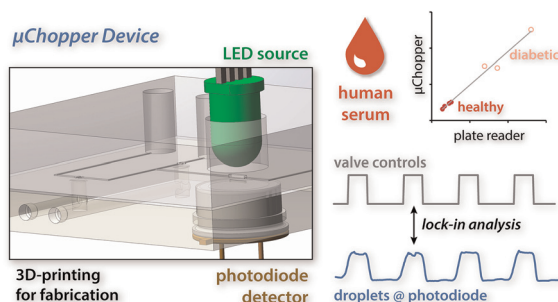
Rafay Ahmed, Mustafa Unal,\* Rekha Gautam, Sasidhar Uppuganti, Shrey Derasari, Anita Mahadevan-Jansen and Jeffry S. Nyman



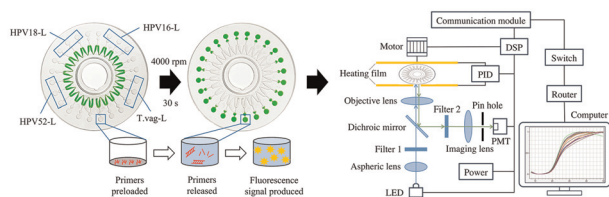
4810

## Droplet-based $\mu$ Chopper device with a 3D-printed pneumatic valving layer and a simple photometer for absorbance based fructosamine quantification in human serum

Yvette Kayirangwa, Md Mohibullah and Christopher J. Easley\*



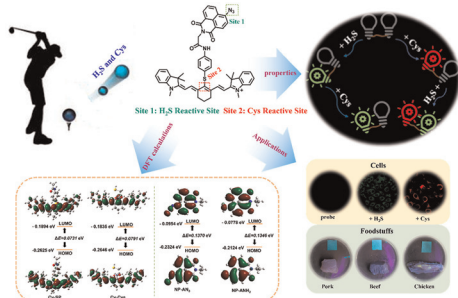
4820



### A microfluidic-chip-based system with loop-mediated isothermal amplification for rapid and parallel detection of *Trichomonas vaginalis* and human papillomavirus

Zeyin Mao, Anni Deng, Xiangyu Jin, Meng Li, Wenqi Lv, Leyang Huang, Hao Zhong, Han Yang, Shihong Wang, Yixuan Shi, Lei Zhang,\* Qinqing Liao\* and Guoliang Huang\*

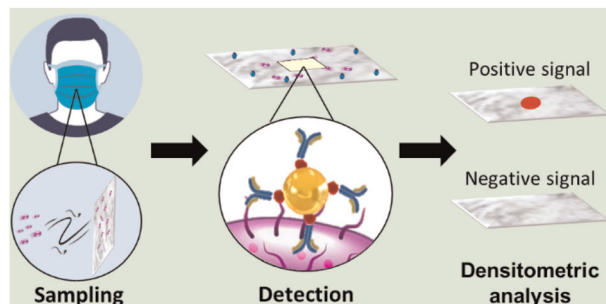
4829



### A dual-response NIR fluorescent probe for separately and continuously recognizing H<sub>2</sub>S and Cys with different fluorescence signals and its applications

Lisha Yue, Yin Ai, Gang Liu, Haichang Ding\* and Shouzhi Pu\*

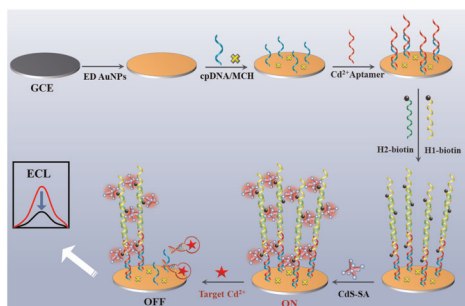
4837



### Facemask analyses for the non-invasive detection of chronic and acute *P. aeruginosa* lung infections using nanoparticle-based immunoassays

David Delgado-Cano, Antonio Clemente,\* Cristina Adrover-Jaume, Andreu Vaquer, Meritxell López, Rocío Martínez, Isabel M. Roig, Amanda Iglesias, Borja G. Cosío and Roberto de la Rica

4844



### A novel DNA-quantum dot nanostructure electrochemiluminescence aptamer sensor by chain reaction amplification for rapid detection of trace Cd<sup>2+</sup>

Runze Wang, Yu Zhao and Guifen Jie\*



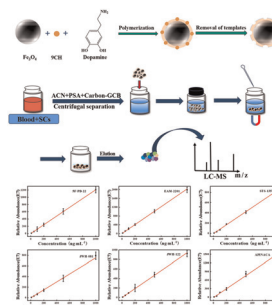


## PAPERS

4850

### Sensitive detection of synthetic cannabinoids in human blood using magnetic polydopamine molecularly imprinted polymer nanocomposites

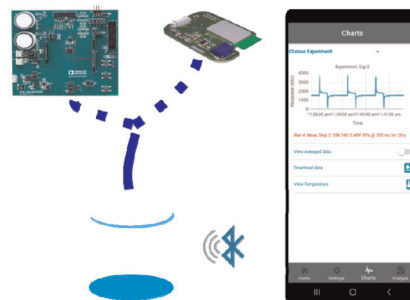
Jiajia Li, Yong Wang, Anran Liu and Songqin Liu\*



4857

### Platform-agnostic electrochemical sensing app and companion potentiostat

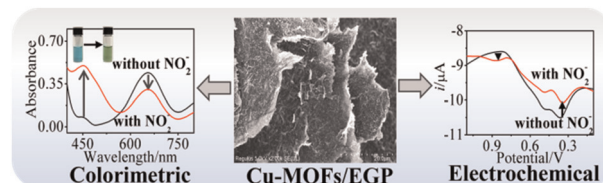
Vijayalaxmi Manoharan, Rui Rodrigues, Sara Sadati, Marcus J. Swann, Neville Freeman, Bowen Du, Ender Yildirim, Ugur Tamer, Theodoros N. Arvanitis, Dmitry Isakov, Ali Asadipour\* and Jérôme Charmet\*



4869

### Diazo-reaction based dual-mode colorimetric-electrochemical sensing of nitrite in pickled food

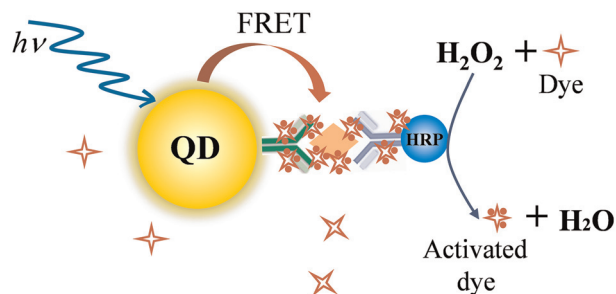
Yixin Pan, Jing Jiang and Xianwen Kan\*



4877

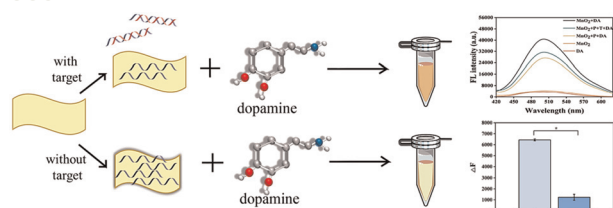
### Homogeneous immunoassay utilizing fluorescence resonance energy transfer from quantum dots to tyramide dyes deposited on full immunocomplexes

Zihan Xu, Xiaojun Liu, Chenghua Zong, Qingquan Zhang and Hongwei Gai\*



## PAPERS

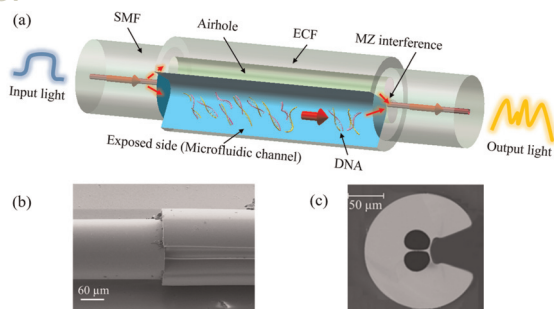
4885



### A label-free fluorescent sensor for rapid and sensitive detection of ctDNA based on fluorescent PDA nanoparticles

Xiao Yang, Yang Huang, Siyi Yang, Miao Tang, Juan Liu, Jinhui Shen, Huanbao Fa, Danqun Huo, Changjun Hou\* and Mei Yang\*

4897



### Label-free DNA quantification using isothermal amplification on an exposed core optical fiber microfluidic platform

Xuegang Li, He Zhang, Yanan Zhang, Yong Zhao, Linh Viet Nguyen, Xue Zhou\* and Stephen C. Warren-Smith

## CORRECTION

4905

### Correction: Voltammetric pH sensor based on electrochemically modified pseudo-graphite

Haoyu Zhu, Tanim Hassan, Humayun Kabir, Jeremy May, Kailash Hamal, Ricardo Lopez, Hailey J. Smith, Nolan W. Nicholas, Prasanna Sankaran, David N. McIlroy and I. Francis Cheng\*

