

## IN THIS ISSUE

ISSN 0003-2654 CODEN ANALAO 148(16) 3679–3940 (2023)



### Cover

See Ronghan Wei,  
Qidong Zhang et al.,  
pp. 3724–3729.

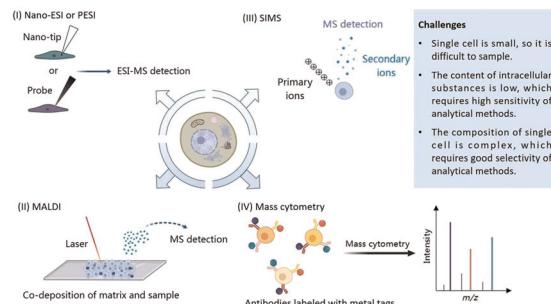
Image reproduced by  
permission of Qidong Zhang  
from *Analyst*, 2023, **148**,  
3724.

## CRITICAL REVIEWS

3690

### Mass spectrometry-based techniques for single-cell analysis

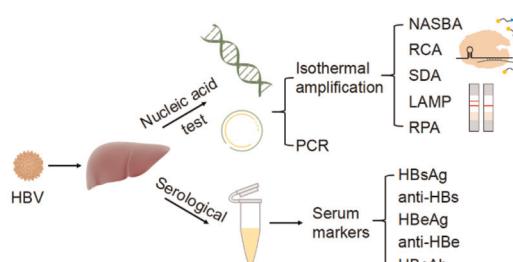
Xiangyi Xu, Xuanxi Jiang, Meiyun Shi\* and Lei Yin\*



3708

### Advances in isothermal nucleic acid amplification methods for hepatitis B virus detection

Huilin Li, Wenjun Song, Hongying Li, Jiaqi Cui,  
Yuchen Xie, Bo Wu\* and Rong Chen\*



Schematic diagram of main methods for hepatitis B detection



# Analyst

rsc.li/analyst

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

## Editorial Staff

### Executive Editor

Philippa Ross

### Deputy Editor

Alice Smallwood

### Editorial Production Manager

Jason Woolford

### 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  
Jason Woolford, Editorial production manager, in the first  
instance. E-mail [analyst@rsc.org](mailto:analyst@rsc.org)

For pre-submission queries please contact  
Philippa Ross, 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)

## Editorial Board

### Editor-in-Chief

Norman Dovichi, University of Notre Dame, USA

Karen Faulds, University of Strathclyde, UK

Hua-Zhong Yu, Simon Fraser University, Canada

### Associate Editors

Damien Arrigan, Curtin University, Australia

Hideaki Hisamoto, Osaka Metropolitan University, Japan

Jun-Jie Zhu, Nanjing University, China

Ryan Bailey, University of Michigan, USA

Baohong Liu, Fudan University, China

Jaebum Choo, Chung-Ang University, South Korea

Nicole Pamme, Stockholm University, Sweden

### Members

Susan Lunte, University of Kansas, USA

## Advisory Board

Matthew Baker, University of Central Lancashire, UK

USA

Paul W Bohn, University of Notre Dame, USA

Kagan Kerman, University of Toronto, Canada

Claudia Conti, CNR, Italy

Christine Kranz, Ulm University, Germany

R Graham Cooks, Purdue University, USA

Annamalai Senthil Kumar, Vellore Institute of Technology University, India

Jeffrey Dick, Purdue University, USA

Xiujun Li, University of Texas at El Paso, USA

Volker K. Deckert, University of Jena, Germany

Lanqun Mao, Institute of Chemistry, Chinese Academy of Sciences, China

Joshua Edel, Imperial College London, UK

Maria Marin, University of East Anglia, UK

Qun Fang, Zhejiang University, China

Pavel Matousek, Rutherford Appleton Laboratory, UK

Facundo Fernandez, Georgia Institute of Technology, USA

Wei Min, Columbia University, USA

Roy Goodacre, University of Liverpool, UK

Boris Mizaikoff, University of Ulm, Germany

Duncan Graham, University of Strathclyde, UK

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

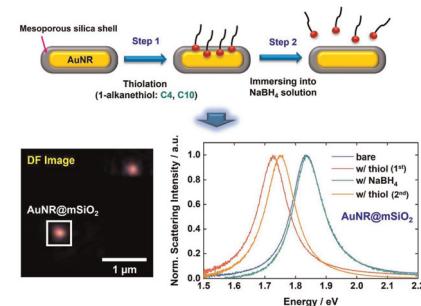


## COMMUNICATION

3719

***In situ* reversible tuning of chemical interface damping in mesoporous silica-coated gold nanorods via direct adsorption and removal of thiol**

Yun A. Hong and Ji Won Ha\*

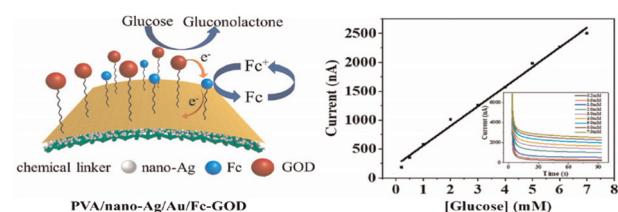


## PAPERS

3724

**A flexible electrochemical glucose sensing platform based on an electrospun PVA mat covered with *in situ* grown silver nanoparticles and a mixed self-assembled monolayer of glucose oxidase and ferrocene**

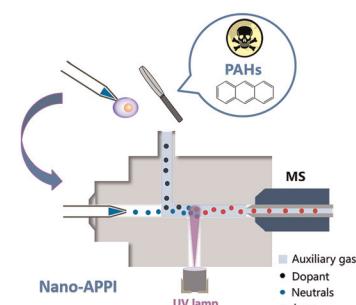
Yu Wang, Qiyan Wang, Guobi Chai, Wu Fan, Qingzhao Shi, Wenfen Zhang, Jian Mao, Jianping Xie, Ronghan Wei\* and Qidong Zhang\*



3730

**Nanoliter atmospheric pressure photoionization-mass spectrometry for direct bioanalysis of polycyclic aromatic hydrocarbons**

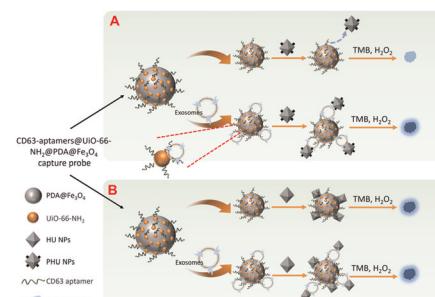
Siyuan Tan,\* Xinchi Yin, Lulu Feng, Juduo Wang, Zhichao Xue, You Jiang, Xinhua Dai, Xiaoyun Gong\* and Xiang Fang\*



3740

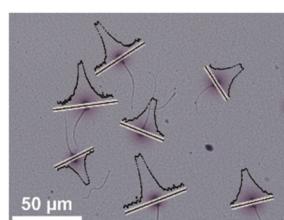
**Aptasensors with palladium nanoparticle-modified hemin-containing metal-organic frameworks as the signal marker for detection of exosomes**

Wei Li, Huili Wang, Xinxin Ying, Zhen Liang, Jianna Li,\* Xiangjuan Chen, Lei Su\* and Xueji Zhang\*



## PAPERS

3748

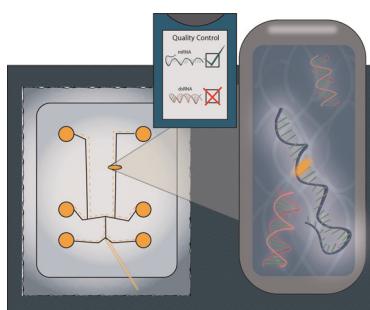


Automated DNA analysis of thousands of sperm cells

## High-throughput sperm DNA analysis at the single-cell and population levels

Mohammad Simchi, Jason Riordon, Yihe Wang, Christopher McCallum, Jae Bem You, Keith Jarvi, Reza Nosrati\* and David Sinton\*

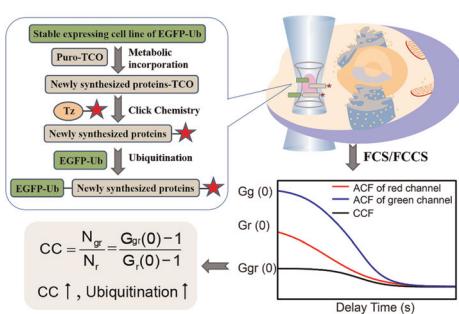
3758



## A microfluidic electrophoretic dual dynamic staining method for the identification and relative quantitation of dsRNA contaminants in mRNA vaccines

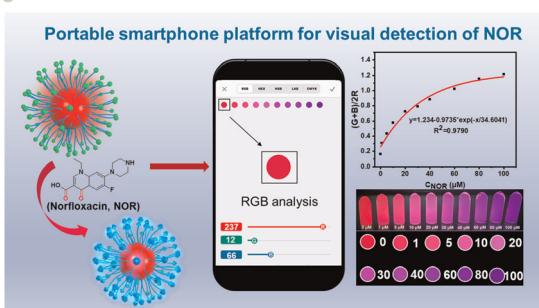
Adriana Coll De Peña, Nina Li, Matei Vaduva, Lloyd Bwanali and Anubhav Tripathi\*

3768

*In vivo* monitoring of the ubiquitination of newly synthesized proteins in living cells by combining a click reaction with fluorescence cross-correlation spectroscopy (FCCS)

Yaoqi Liu, Chaoqing Dong\* and Jicun Ren\*

3776

 $\text{Y}^{3+}@\text{CdTe}$  quantum dot nanoprobe as a fluorescence signal enhancement sensing platform for the visualization of norfloxacin

Xiong Chen, Yuanhang Jiang, Ying Liu and Cheng Yao\*

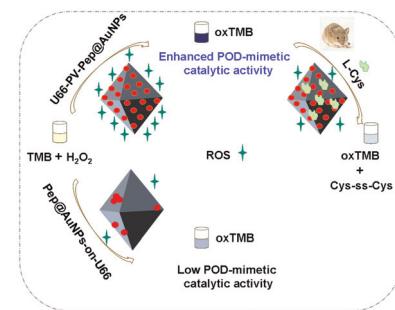


## PAPERS

3785

**Enhancing the catalytic performance of MOF-polymer@AuNP-based nanozymes for colorimetric detection of serum L-cysteine**

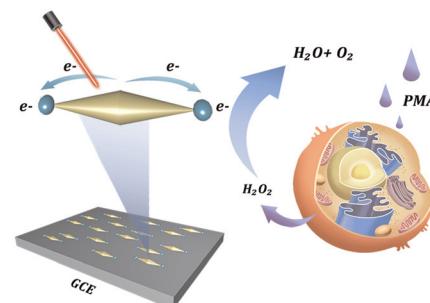
Lin Tian, Cheng Cheng, Zhenwen Zhao, Wei Liu and Li Qi\*



3791

**Sensitive detection of extracellular hydrogen peroxide using plasmon-enhanced electrochemical activity on Pd-tipped Au nanobipyramids**

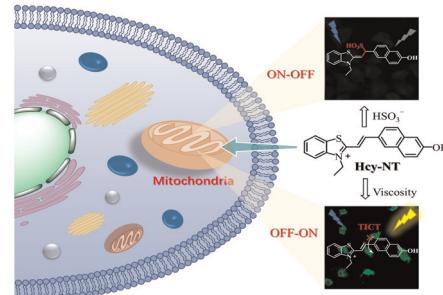
Wenli Jiang, Die Sun, Chenxin Cai and Hui Zhang\*



3798

**"One stone, two birds": a mitochondria-targeted fluorescent probe for the detection of viscosity and  $\text{HSO}_3^-$  in living cells**

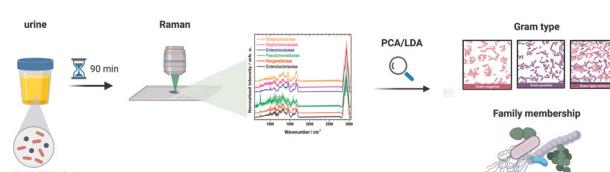
Buyue Zhang, Lei Shi,\* Xiaoying Ma, Dawei Yang, Hongxia Sun, Yalin Tang and Xiufeng Zhang\*



3806

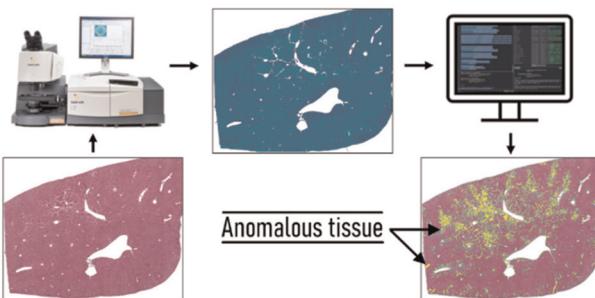
**Identification of bacteria in mixed infection from urinary tract of patient's samples using Raman analysis of dried droplets**

Kateřina Aubrechtová Dragounová, Oleg Ryabchikov, Daniel Steinbach, Vincent Recla, Nora Lindig, María José González Vázquez, Susan Foller, Michael Bauer, Thomas W. Bocklitz, Jürgen Popp, Jürgen Rödel and Ute Neugebauer\*



## PAPERS

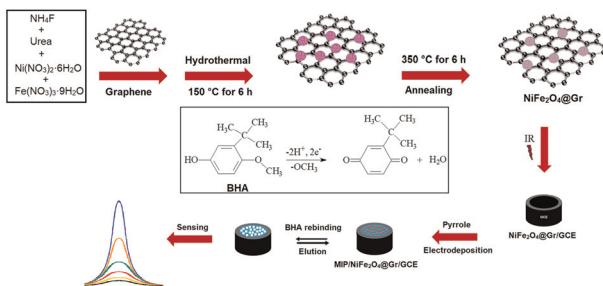
3817



**Weakly supervised anomaly detection coupled with Fourier transform infrared (FT-IR) spectroscopy for the identification of non-normal tissue**

Dougal Ferguson,\* Alex Henderson, Elizabeth F. McInnes and Peter Gardner

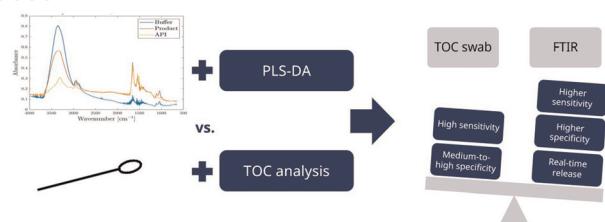
3827



**A novel electrochemical detection method for butylated hydroxyanisole (BHA) as an antioxidant: a BHA imprinted polymer based on a nickel ferrite@graphene nanocomposite and its application**

Bahar Banko\u0111lu Yola, Sena Bekerecio\u0111lu, İlknur Polat, Necip Atar and Mehmet Lütfi Yola\*

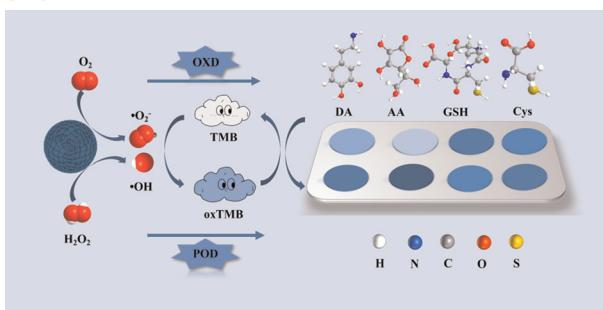
3835



**Handheld FTIR outperforms total organic carbon swab in pharmaceutical cleaning validation**

Isabella Jul-Jørgensen,\* Krist V. Gernaey and Christian A. Hundahl

3843



**Colorimetric sensor arrays for antioxidant recognition based on  $\text{Co}_3\text{O}_4$  dual-enzyme activities**

Pingping Hao, Zhenchao Liu, Zhiwei Wang, Min Xie\* and Qingyun Liu\*

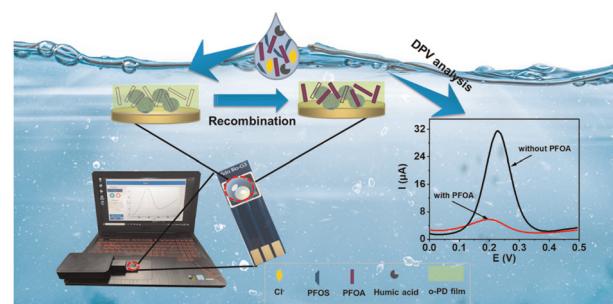


## PAPERS

3851

**A portable molecularly imprinted polymer-modified microchip sensor for the rapid detection of perfluorooctanoic acid**

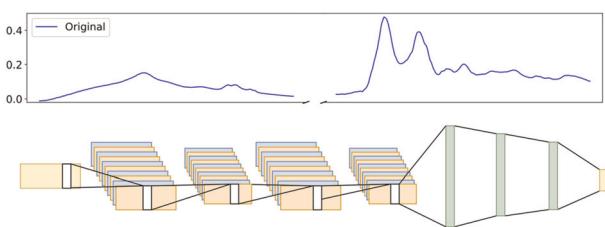
Yingmei Wei, Hongjie Liu, Shaopeng Wang, Kefu Yu\* and Liwei Wang\*



3860

**Augmentation of FTIR spectral datasets using Wasserstein generative adversarial networks for cancer liquid biopsies**

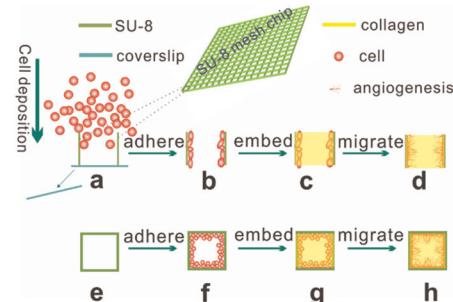
Rose G. McHardy, Georgios Antoniou, Justin J. A. Conn, Matthew J. Baker and David S. Palmer\*



3870

**On-chip-angiogenesis based on a high-throughput biomimetic three-dimensional cell spheroid culture system**

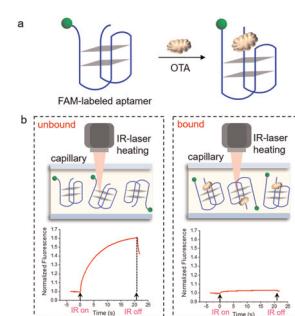
Yachao Wang, Xuemei Zeng, Peng Chen, Wei Du, Yumei Pei,\* Guoping Wang\* and Bi-Feng Liu



3876

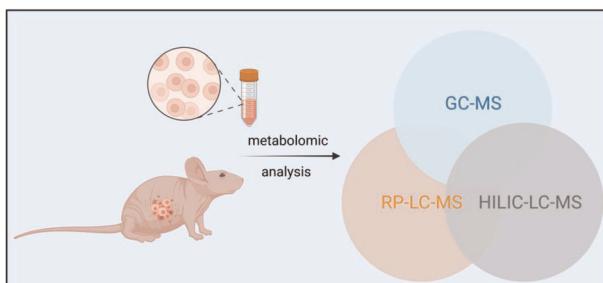
**Sensitive microscale thermophoresis assay for rapid ochratoxin A detection with fluorescently labeled engineered aptamer**

Hao Yu and Qiang Zhao\*



## PAPERS

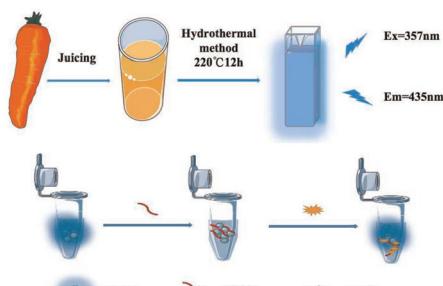
3883



**A multiplatform metabolomics approach for comprehensive analysis of GIST xenografts with various *KIT* mutations**

Szymon Macioszek, Danuta Dudzik, Margot Biesemans, Agnieszka Wozniak, Patrick Schöffski and Michał J. Markuszewski\*

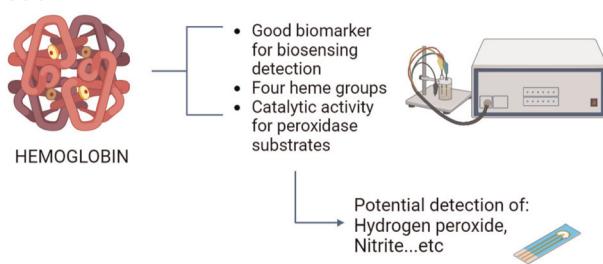
3892



**A fluorescent biosensor based on carbon quantum dots and single-stranded DNA for the detection of *Escherichia coli***

Xiaolian Bai, Lu Ga and Jun Ai\*

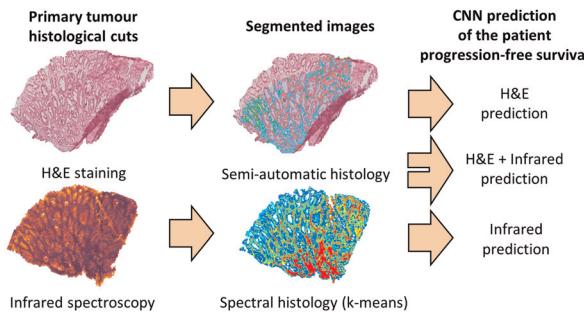
3899



**Design of a label-free aptasensor for electrochemical determination of hemoglobin: investigation of the peroxidase-like activity of hemoglobin for the sensing of different substrates**

Ahlem Teniou, Amina Rhouati,\* Selma Rabai, Gaëlle Catanante and Jean-Louis Marty

3909



**Deep learning for the prediction of the chemotherapy response of metastatic colorectal cancer: comparing and combining H&E staining histopathology and infrared spectral histopathology**

Benjamin Brunel, Pierre Prada, Florian Slimano, Camille Boulagnon-Rombi, Olivier Bouché and Olivier Piot\*

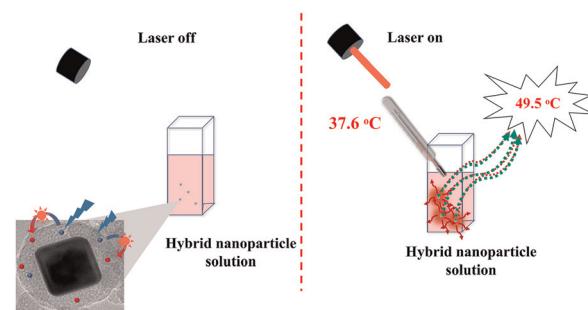


## PAPERS

3918

**A plasmonic fluorescent ratiometric temperature sensor for self-limiting hyperthermic applications utilizing FRET enhancement in the plasmonic field**

Sharon George and Shajesh Palantavida\*



3931

**The colorimetry and smartphone determination of perfluorooctane sulfonate based on cytidine 5'-monophosphate-capped gold nanoclusters with peroxidase-like activity**

Tian-Yuan Guo, Hong-Wei Li, Chun-Xia Zhang and Yuqing Wu\*

