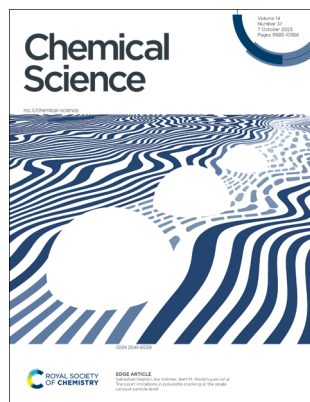


## IN THIS ISSUE

ISSN 2041-6539 CODEN CSHCBM 14(37) 9983–10366 (2023)



**Cover**  
See Sebastian Rejman, Ina Vollmer, Bert M. Weckhuysen *et al.*, pp. 10068–10080. Image reproduced by permission of B.M. Weckhuysen from *Chem. Sci.*, 2023, **14**, 10068. Artwork by Dr Thomas Hartman (Utrecht University).



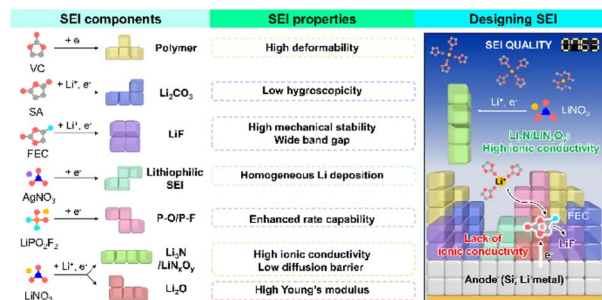
**Inside cover**  
See Yujiro Hayashi *et al.*, pp. 10081–10086. Image reproduced by permission of Miho Iwabuchi from *Chem. Sci.*, 2023, **14**, 10081.

## REVIEWS

9996

### Liquid electrolyte chemistries for solid electrolyte interphase construction on silicon and lithium-metal anodes

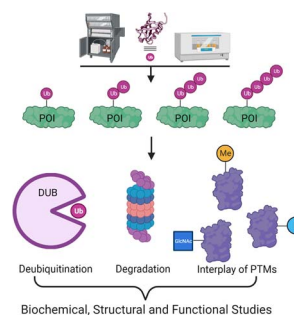
Sewon Park, Saehun Kim, Jeong-A. Lee, Makoto Ue and Nam-Soon Choi\*



10025

### Synthesis of ubiquitinated proteins for biochemical and functional analysis

Julia Kriegesmann and Ashraf Brik\*



## Editorial Staff

### Executive Editor

May Copsy

### Deputy Editor

Samantha Apps

### Senior Editor

James Moore

### Scientific Editors

Ellis Crawford, Jingtao Huang, Esther Johnston, Sophie Orchard, Richard Thompson and Amy Welch

### Editorial Assistant

Karina Webster

### Publishing Assistant

David Bishop

For queries about submitted articles please contact James Moore, Senior Editor, in the first instance. E-mail [chemicalscience@rsc.org](mailto:chemicalscience@rsc.org)

For pre-submission queries please contact May Copsy, Executive Editor. E-mail [chemicalscience-rsc@rsc.org](mailto:chemicalscience-rsc@rsc.org)

Chemical Science (electronic: ISSN 2041-6539) is published 48 times a year by the Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK.

Chemical Science is a Gold Open Access journal and all articles from 2015 onwards are free to read.

Please email [orders@rsc.org](mailto:orders@rsc.org) to register your interest or contact 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)

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)

# Chemical Science

[rsc.li/chemical-science](http://rsc.li/chemical-science)

## Editorial Board

### Editor-in-Chief

Andrew Cooper, University of Liverpool

### Associate Editors

Vincent Artero, CEA-Grenoble  
Luis M. Campos, Columbia University  
Michelle Chang, University of California, Berkeley  
Lin X. Chen, Northwestern University  
Graeme Day, University of Southampton  
Serena DeBeer, Max Planck Institute for Chemical Energy Conversion

Mircea Dincă, MIT

François Gabbai, Texas A&M University  
Subi George, JNCASR  
Ryan Gilmour, WWU Münster  
Jinlong Gong, Tianjin University  
Stephen Goldup, University of Birmingham  
Zaiping Guo, University of Adelaide  
Christopher A. Hunter, University of Cambridge  
Malika Jefferies-EL, Boston University  
Ning Jiao, Peking University  
Tanja Junkers, Monash University

Hemamala Karunadasa, Stanford University  
Maja Köhn, University of Freiburg  
Yi-Tao Long, Nanjing University  
Gabriel Merino, CINVESTAV Merida  
James K. McCusker, Michigan State University  
Thomas Meade, Northwestern University  
Paolo Melchiorre, University of Bologna  
Carsten Schultz, Oregon Health & Science University  
Dmitri Talapin, The University of Chicago  
Toshiharu Teranishi, Kyoto University  
Andrei Yudin, University of Toronto

## Advisory Board

D. Adams, University of Glasgow  
A. Ajayaghosh, NIIST  
R. Amaro, UC San Diego  
A. Anastasaki, ETH Zürich  
U.-P. Apfel, Ruhr-University Bochum  
K. Asmis, Leipzig University  
X. Bao, DICP-CAS  
Z. Bao, Stanford University  
D. N. Beratan, Duke University  
G. Bernardes, University of Cambridge  
F. Biedermann, KIT  
D. Blackmond, Scripps Research Institute  
E. Blasco, Heidelberg University  
J. Bode, ETH Zurich  
J. S. Brodbelt, UT Austin  
C. Chang, UC Berkeley  
C.-M. Che, University of Hong Kong  
J. Chen, Nankai University  
M. Cohen, OHSU  
C. Coley, MIT  
L. Cronin, University of Glasgow  
J. Crowley, University of Otago  
C. C. Cummins, MIT  
V. Däschlein-Gessner, Ruhr University Bochum  
M. Delbianco, MPICI  
J. Dempsey, UNC Chapel Hill  
W. Dichtel, Northwestern University  
K. Domen, University of Tokyo  
H. Duan, Tsinghua University,  
X. Feng, TU Dresden  
B. Feringa, University of Groningen  
J. Figueroa, UC San Diego  
N. Frank, University of Nevada  
M. Freitag, Newcastle University  
S. Gao, Peking University  
J. Gassensmith, UT Dallas  
G. Gasser, PSL University  
E. Gibson, Newcastle University  
F. Glorius, WWU Münster  
L. González, University of Vienna  
D. Graham, University of Strathclyde  
V. Grassian, UC San Diego  
A. Grimaud, Collège de France/CNRS  
T. Gulder, Leipzig University  
W. Gutekunst, Georgia Tech  
C. Hackenberger, FMP Berlin  
I. Hamachi, Kyoto University  
G. Han, Brandeis University  
B. Han, CAS  
M. Hariharan, IISER-TVM  
C. Haynes, University of Minnesota

J. Heemstra, WUSTL  
T. Heine, DTU  
P. Holland, Yale University  
K. E. Jelfs, Imperial College London  
X. Jiang, Aramco  
Y. Jung, KAIST  
S. Kath-Schorr, University of Cologne  
T. Kato, University of Tokyo  
C. Kelly, Janssen Research/J&J  
R. Klausen, Johns Hopkins University  
Y. Krishnan, University of Chicago  
M. Kuimova, Imperial College London  
K. Lancaster, Cornell University  
A.-L. Lee, Heriot-Watt University  
D. Leonori, University of Manchester  
X. Li, University of Washington  
Y. Li, Jilin University  
M. H. Lim, KAIST  
J. Lloret-Fillol, ICIQ  
B. Lotsch, Max Planck Institute  
X. W. Lou, NTU  
K. Maeda, Tokyo Tech  
S. Maeda, Hokkaido University  
D. Maiti, IIT Bombay  
L. Malins, ANU  
S. Mandal, IISER Kolkata  
T. Martinez, Stanford University  
C. Martínez-Huitle, UFRN  
E. Matson, Rochester University  
J. L. Medina-Franco, UNAM  
V. Moliner, INAM, Jaume I University  
W. Nam, Ewha Womans University  
T. Noël, University of Amsterdam  
A. Obermeyer, Columbia University  
M. Oestreich, TU Berlin  
D. O'Hagan, University of St Andrews  
T. Ooi, Nagoya University  
R. O'Reilly, University of Birmingham  
S. Ott, Uppsala University  
H. Ottosson, Uppsala University  
Z. Ouyang, Tsinghua University  
X. Pan, DICP-CAS  
S. Patel, SSCU-IISC  
E. Pentzer, Texas A&M University  
S. Peter, JNCASR  
W. Piers, University of Calgary  
N. Plumeré, Ruhr-University Bochum  
S. Qiao, University of Adelaide  
V. Rai, IISER Bhopal  
S. Rasmussen, North Dakota State University  
J. Read de Alaniz, UC Santa Barbara

E. Reisner, University of Cambridge  
A. Rentmeister, WWU Munster  
J. Rinehart, UC San Diego  
A. Rothberg, University of Florida  
H. Sardon, UPV-EHU  
R. Sarpong, UC Berkeley  
G. Schatz, Northwestern University  
D. Schultz, Merck  
D. Seferos, University of Toronto  
R. Sessoli, University of Florence  
B. Shafaat, UCLA  
T. Snaddon, Indiana University  
M. Solà, University of Girona  
G. Soler-Illia, UNSAM  
D. Spring, University of Cambridge  
B. Sumerlin, University of Florida  
R. B. Sunoj, IIT Bombay  
Y. Surendranath, MIT  
M. Tada, Nagoya University  
T. Tahara, RIKEN  
Z. Tang, NCSST  
S. Teichert, DESY  
C. Thomas, Ohio State University  
H. Tian, ECUST  
Z.-Q. Tian, Xiamen University  
A. Tkatchenko, University of Luxembourg  
H. Tran, University of Toronto  
T. Uemura, University of Tokyo  
C. Vanderwal, UC Irvine  
L. Venkataraman, Columbia University  
G. Vilé, Politecnico di Milano  
A. Wakamiya, Kyoto University  
L.-S. Wang, Brown University  
C. Wang, Peking University  
E. Weerapana, Boston College  
J. Weinstein, University of Sheffield  
T. Welton, Imperial College London  
A. Wendlandt, MIT  
C. Williams, University of Oxford  
V. Yam, University of Hong Kong  
N. Yanai, Kyushu University  
S. Q. Yao, National University of Singapore  
A. Zarkin, UFPR  
L. Zhang, ECNU  
T. Zhang, TIPC-CAS  
J. Zhang, University of Cambridge  
Z.-J. Zhao, Tianjin University  
B. Zhong Tang, CUHK-Shenzhen  
Q.-L. Zhou, Nankai University

## Information for Authors

Full details on how to submit material for publication in Chemical Science 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/chemical-science](http://rsc.li/chemical-science)

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.

Registered charity number: 207890

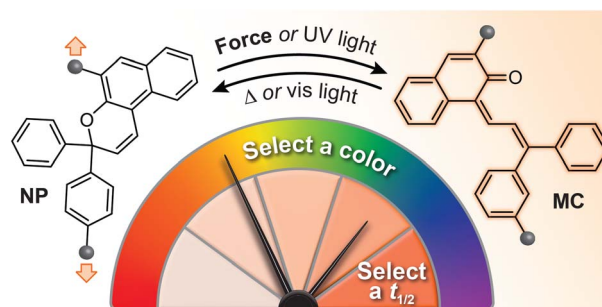


## PERSPECTIVE

10041

**Naphthopyran molecular switches and their emergent mechanochemical reactivity**

Molly E. McFadden, Ross W. Barber, Anna C. Overholts and Maxwell J. Robb\*

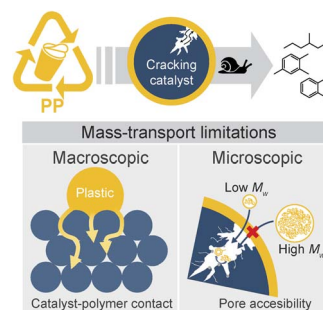


## EDGE ARTICLES

10068

**Transport limitations in polyolefin cracking at the single catalyst particle level**

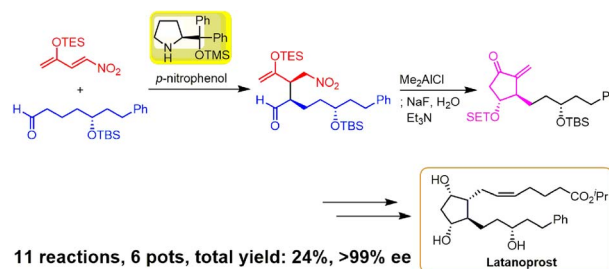
Sebastian Rejman, Ina Vollmer,\* Maximilian J. Werny, Eelco T. C. Vogt, Florian Meirer and Bert M. Weckhuysen\*



10081

**Organocatalyst-mediated, pot-economical total synthesis of latanoprost**

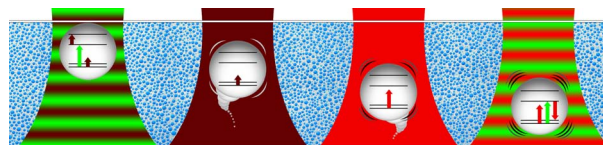
Genki Kawauchi, Yurina Suga, Shunsuke Toda and Yujiro Hayashi\*



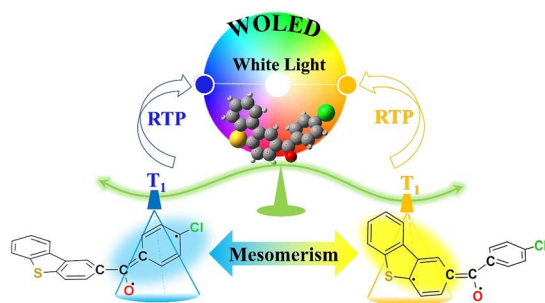
10087

**Gaining control on optical force by the stimulated-emission resonance effect**

Tetsuhiro Kudo,\* Boris Louis, Hikaru Sotome, Jui-Kai Chen, Syoji Ito,\* Hiroshi Miyasaka, Hiroshi Masuhara,\* Johan Hofkens\* and Roger Bresolí-Obach\*



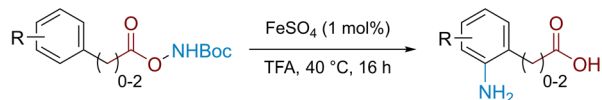
10096



### Mesomerism induced temperature-dependent multicomponent phosphorescence emissions in CIBDBT

Zexing Qu,<sup>\*</sup> Yujie Guo, Jilong Zhang<sup>\*</sup> and Zhongjun Zhou<sup>\*</sup>

10103

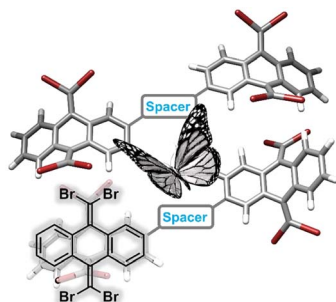


- Simple and practical conditions leading to unprotected anthranilic acids
  - Highly *ortho*-selective
- No precious metal catalysts or bespoke directing groups
  - Effective on various chain lengths
  - Detailed mechanistic studies performed

### *Ortho*-Selective amination of arene carboxylic acids via rearrangement of acyl *O*-hydroxylamines

James E. Gillespie, Nelson Y. S. Lam and Robert J. Phipps<sup>\*</sup>

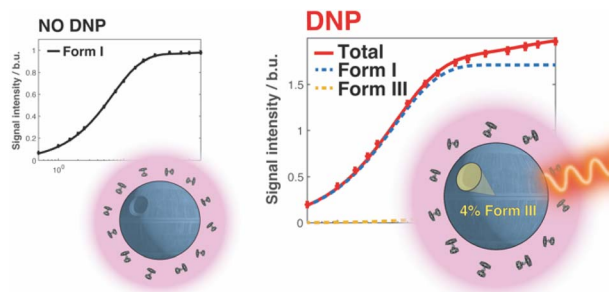
10112



### Dimeric tetrabromo-*p*-quinodimethanes: synthesis and structural/electronic properties

Diego J. Vicent, Manuel Pérez-Escribano, Abel Cárdenas-Valdivia, Ana Barragán, Joaquín Calbo, José I. Urgel, David Écija,<sup>\*</sup> José Santos,<sup>\*</sup> Juan Casado,<sup>\*</sup> Enrique Orti<sup>\*</sup> and Nazario Martín<sup>\*</sup>

10121



### Exploiting solid-state dynamic nuclear polarization NMR spectroscopy to establish the spatial distribution of polymorphic phases in a solid material

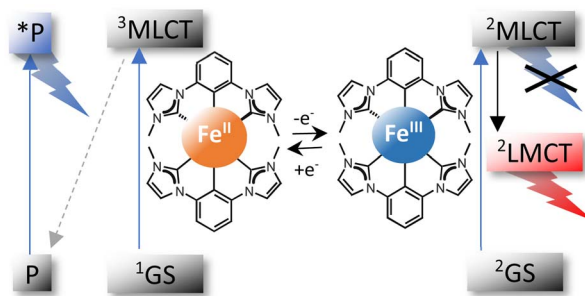
Samuel F. Cousin, Colan E. Hughes, Fabio Ziarelli, Stéphane Viel, Giulia Mollica,<sup>\*</sup> Kenneth D. M. Harris,<sup>\*</sup> Arthur C. Pinon<sup>\*</sup> and Pierre Thureau<sup>\*</sup>



10129

### Ferrous and ferric complexes with cyclometalating N-heterocyclic carbene ligands: a case of dual emission revisited

Catherine Ellen Johnson, Jesper Schwarz, Mawuli Deegbey, Om Prakash, Kumkum Sharma, Ping Huang, Tore Ericsson, Lennart Häggström, Jesper Bendix, Arvind Kumar Gupta, Elena Jakubikova,\* Kenneth Wärnmark\* and Reiner Lomoth\*

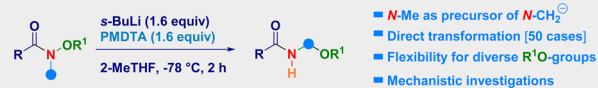


10140

### Base-mediated homologative rearrangement of nitrogen–oxygen bonds of N-methyl-N-oxyamides

Monika Malik, Raffaele Senatore, Thierry Langer, Wolfgang Holzer and Vittorio Pace\*

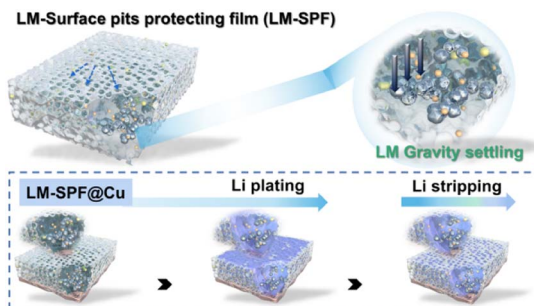
Direct homologation of N–O bond without an external C1-source



10147

### A liquid metal-fluoropolymer artificial protective film enables robust lithium metal batteries at sub-zero temperatures

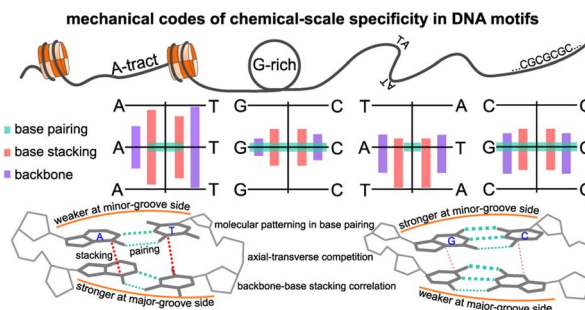
Hongbao Li, Rong Hua, Yang Xu, Da Ke, Chenyu Yang, Quanwei Ma, Longhai Zhang, Tengfei Zhou\* and Chaofeng Zhang\*



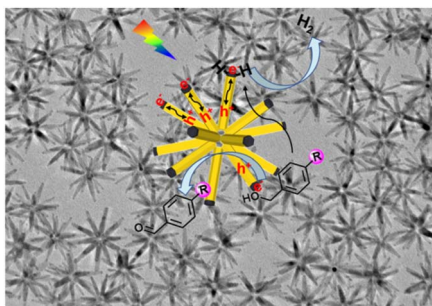
10155

### Mechanical codes of chemical-scale specificity in DNA motifs

Yi-Tsao Chen, Haw Yang and Jhieh-Wei Chu\*



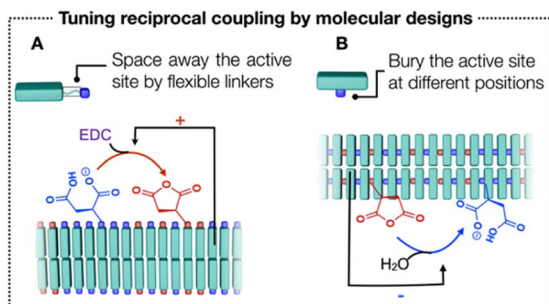
10167



### Versatile synthesis of nano-icosapods via cation exchange for effective photocatalytic conversion of biomass-relevant alcohols

Dan Xu, Li Zhai, Zhangyan Mu, Chen-Lei Tao, Feiyue Ge, Han Zhang, Mengning Ding, Fang Cheng\* and Xue-Jun Wu\*

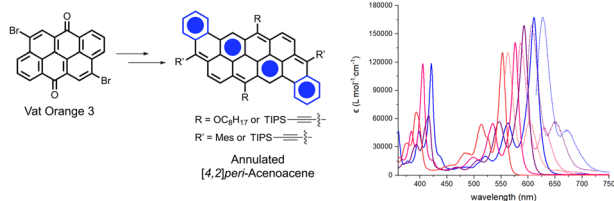
10176



### Design rules for reciprocal coupling in chemically fueled assembly

Xiaoyao Chen, Brigitte A. K. Kriebisch, Alexander M. Bergmann and Job Boekhoven\*

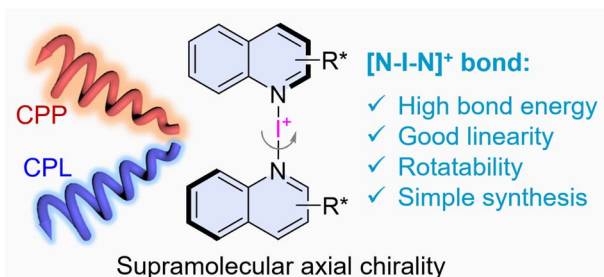
10184



### Dibenzannulated *peri*-acenoacenes from anthanthrene derivatives

Frédéric Lirette, Ali Darvish, Zheng Zhou, Zheng Wei, Lukas Renn, Marina A. Petrukhina, R. Thomas Weitz and Jean-François Morin\*

10194



### Supramolecular axial chirality in [N-I-N]<sup>+</sup>-type halogen bonded dimers

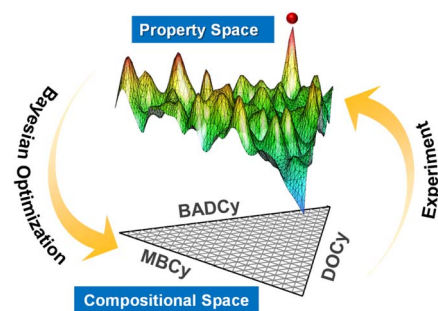
Shuguo An, Aiyu Hao and Pengyao Xing\*



10203

## Efficient exploration of compositional space for high-performance copolymers via Bayesian optimization

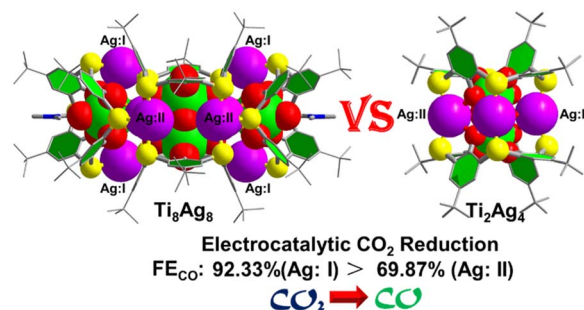
Xinyao Xu, Wenlin Zhao, Liquan Wang,\* Jiaping Lin\* and Lei Du



10212

## Stepwise assembly of thiacalix[4]arene-protected Ag/Ti bimetallic nanoclusters: accurate identification of catalytic Ag sites in CO<sub>2</sub> electroreduction

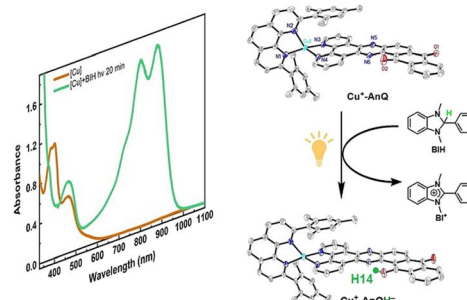
Yi-Qi Tian, Wen-Lei Mu, Lin-Lin Wu,\* Xiao-Yi Yi, Jun Yan\* and Chao Liu\*



10219

## Photochemical charge accumulation in a heteroleptic copper(I)-anthraquinone molecular dyad via proton-coupled electron transfer

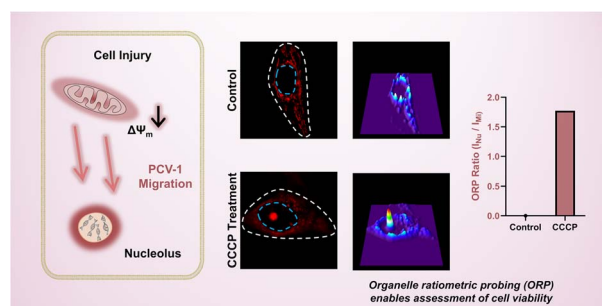
Zhu-Lin Xie, Nikita Gupta, Jens Niklas, Oleg G. Poluektov, Vincent M. Lynch, Ksenija D. Glusac and Karen L. Mulfort\*



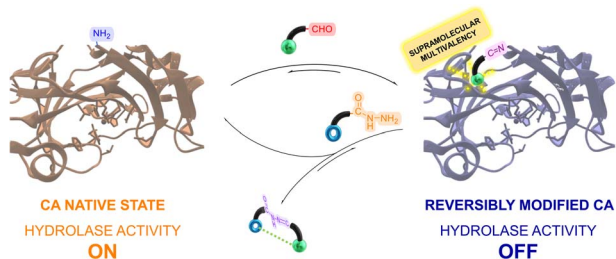
10236

## Quantifying cell viability through organelle ratiometric probing

Rui Chen, Kangqiang Qiu, Guanqun Han, Bidyut Kumar Kundu, Guodong Ding, Yujie Sun\* and Jiajie Diao\*



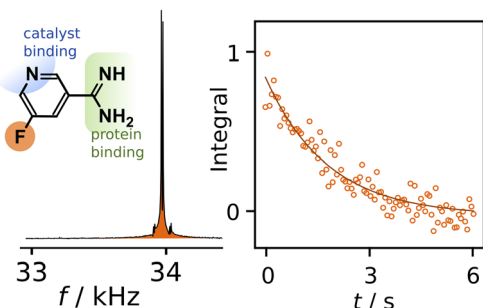
10249



### Supramolecular multivalency effects enhance imine formation in aqueous medium allowing for dynamic modification of enzymatic activity

Ferran Esteve,\* Fidan Rahmatova and Jean-Marie Lehn\*

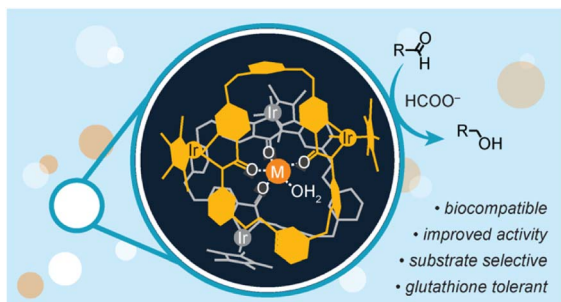
10258



### Biomolecular interactions studied by low-field NMR using SABRE hyperpolarization

Pierce Pham and Christian Hilty\*

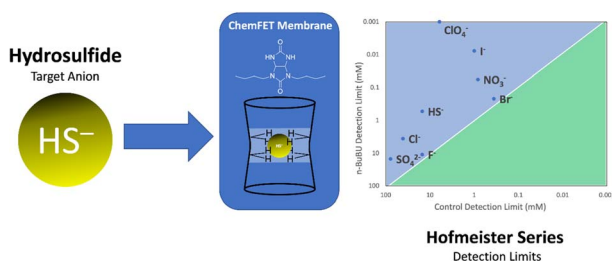
10264



### Lewis acid-driven self-assembly of diiridium macrocyclic catalysts imparts substrate selectivity and glutathione tolerance

Hieu D. Nguyen, Rahul D. Jana, Dylan T. Campbell, Thi V. Tran and Loi H. Do\*

10273



### Benchmarking the placement of hydrosulfide in the Hofmeister series using a bambus[6]uril-based ChemFET sensor

Grace M. Kuhl, Douglas H. Banning, Hazel A. Fargher, Willow A. Davis, Madeline M. Howell, Lev N. Zakharov, Michael D. Pluth\* and Darren W. Johnson\*

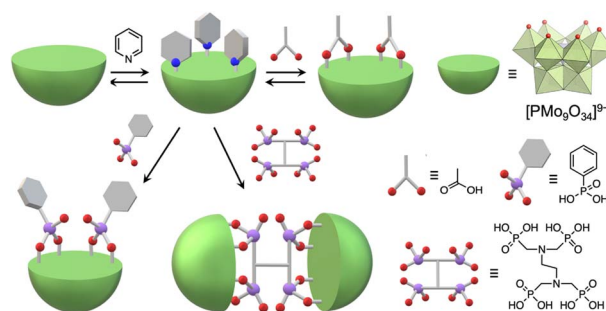




10280

### Molecular hybrids of trivacant lacunary polyoxomolybdate and multidentate organic ligands

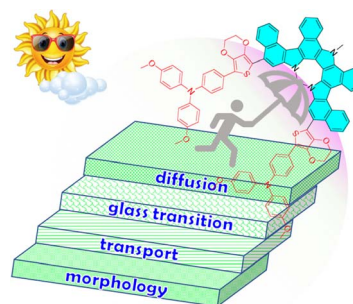
Atsuhiko Jimbo, Chifeng Li, Kentaro Yonesato, Tomoki Ushiyama, Kazuya Yamaguchi and Kosuke Suzuki\*



10285

### Molecular engineering of nitrogen-rich helicene based organic semiconductors for stable perovskite solar cells

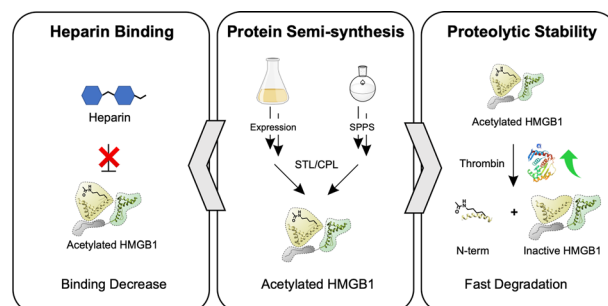
Yuefang Wei, Yaohang Cai, Lifei He, Yuyan Zhang, Yi Yuan,\* Jing Zhang and Peng Wang\*



10297

### Revealing the extracellular function of HMGB1 N-terminal region acetylation assisted by a protein semi-synthesis approach

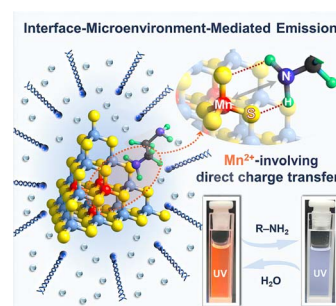
Tongyao Wei, Jiamei Liu, Can Li, Yi Tan, Ruohan Wei, Jinzheng Wang, Hongxiang Wu, Qingrong Li, Heng Liu, Yubo Tang and Xuechen Li\*



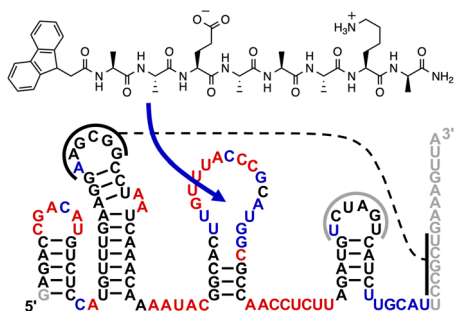
10308

### The interface microenvironment mediates the emission of a semiconductor nanocluster via surface-dopant-involving direct charge transfer

Zhiqiang Wang, Hao Ma, Jiayu Zhang, Yingjia Lan, Jia-Xing Liu, Shang-Fu Yuan, Xiao-Ping Zhou, Xiaohong Li, Chaochao Qin, Dong-Sheng Li and Tao Wu\*



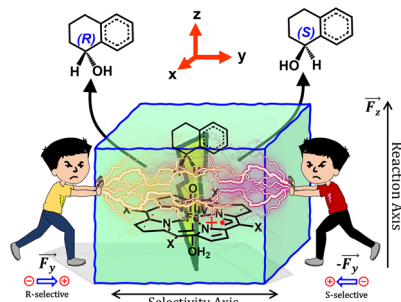
10318



### Peptide conjugates with polyaromatic hydrocarbons can benefit the activity of catalytic RNAs

Kevin J. Sweeney, Tommy Le, Micaella Z. Jorge, Joan G. Schellinger, Luke J. Lemman and Ulrich F. Müller\*

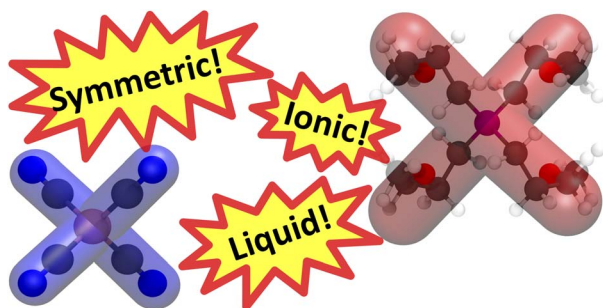
10329



### A porphyrin-based molecular cage guided by designed local-electric field is highly selective and efficient

Shakir Ali Siddiqui, Sason Shaik,\* Surajit Kalita and Kshatresh Dutta Dubey\*

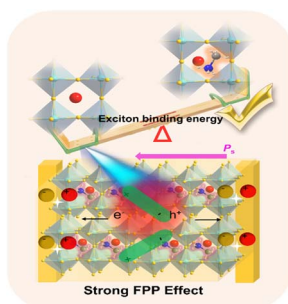
10340



### Room temperature ionic liquids with two symmetric ions

Daniel Rauber,\* Frederik Philippi,\* Daniel Schroeder, Bernd Morgenstern, Andrew J. P. White, Marlon Jochum, Tom Welton and Christopher W. M. Kay\*

10347



### Mixing cage cations in 2D metal-halide ferroelectrics enhances the ferro-pyro-phototronic effect for self-driven photopyroelectric detection

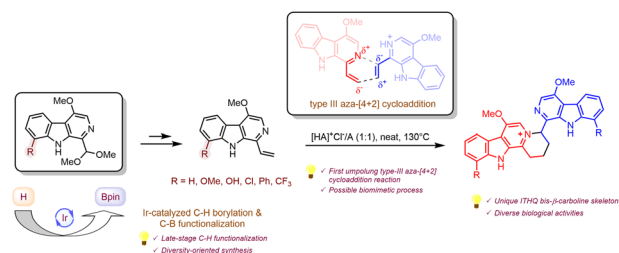
Yu Ma, Wenjing Li, Yi Liu, Wuqian Guo, Haojie Xu, Shiguo Han, Liwei Tang, Qingshun Fan, Junhua Luo and Zhihua Sun\*



10353

## Divergent total syntheses of ITHQ-type bis- $\beta$ -carboline alkaloids by regio-selective formal aza-[4 + 2] cycloaddition and late-stage C–H functionalization

Qixuan Wang, Fusheng Guo, Jin Wang and Xiaoguang Lei\*



## CORRECTIONS

10360

## Further correction: Expanding medicinal chemistry into 3D space: metallofragments as 3D scaffolds for fragment-based drug discovery

Christine N. Morrison, Kathleen E. Prosser, Ryjul W. Stokes, Anna Cordes, Nils Metzler-Nolte and Seth M. Cohen\*

10363

## Correction: Self-quenched ferrocenyl diketopyrrolopyrrole organic nanoparticles with amplifying photothermal effect for cancer therapy

Pingping Liang, Qianyun Tang, Yu Cai, Gongyuan Liu, Weili Si, Jinjun Shao, Wei Huang,\* Qi Zhang\* and Xiaochen Dong\*

