

Energy & Environmental Science

rsc.li/ees

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 1754–5706 CODEN EESNBY 18(15) 7315–7722 (2025)



Cover

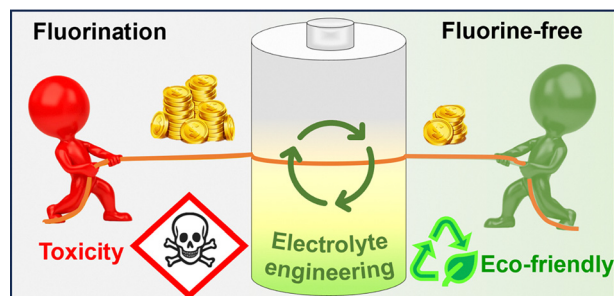
See Yosef Nikodimos, Wei-Nien Su, Bing Joe Hwang *et al.*, pp. 7326–7372. Image reproduced by permission of Bing Joe Hwang from *Energy Environ. Sci.*, 2025, **18**, 7326.

REVIEWS

7326

Fluorine-free electrolytes in batteries: principles, strategies, and advances

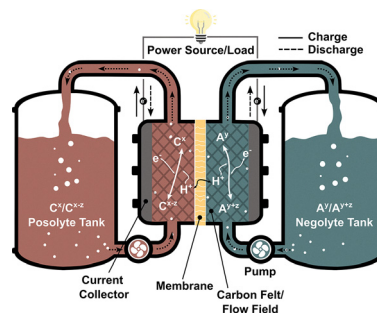
Boligarla Vinay, Yosef Nikodimos,* Tripti Agnihotri, Shadab Ali Ahmed, Teklay Mezgebe Hagos, Rehbar Hasan, Elango Balaji Tamilarasan, Wei-Nien Su* and Bing Joe Hwang*



7373

Monitoring chemical processes in redox flow batteries employing *in situ* and *in operando* analyses

Ahmad Alem, Pooria Poormehrabi, Jonas Lins, Lukas Pachernegg-Mair, Christine Bandl, Virginia Ruiz, Edgar Ventosa, Stefan Spirk* and Torsten Gutmann*



**GOLD
OPEN
ACCESS**

EES Batteries

**Exceptional research on
batteries and energy storage**

 Part of the EES family

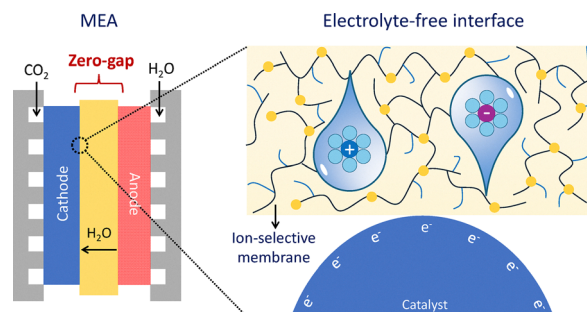
**Join
in** | Publish with us
rsc.li/EESBatteries

PERSPECTIVE

7402

Unraveling the electrolyte-free interface in membrane CO₂ electrolyzers

Wenhao Ren, Yao Zheng and Shi-Zhang Qiao*

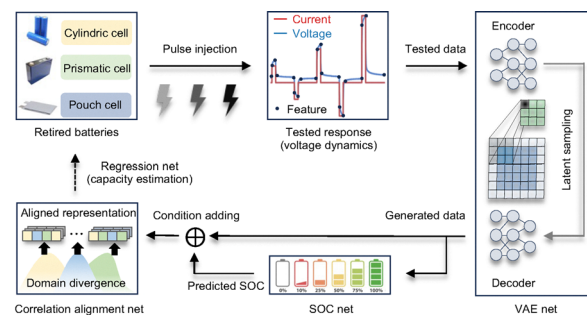


PAPERS

7413

Immediate remaining capacity estimation of heterogeneous second-life lithium-ion batteries via deep generative transfer learning

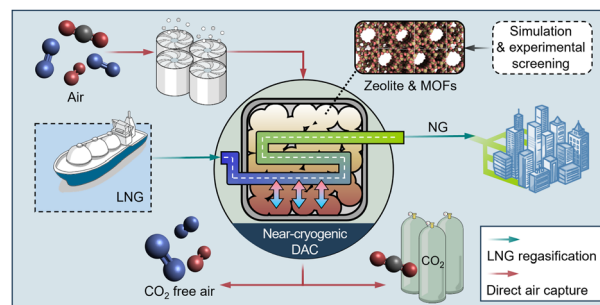
Shengyu Tao, Ruohan Guo, Jaewoong Lee, Scott Moura, Lluc Canals Casals, Shida Jiang, Junzhe Shi, Stephen Harris, Tongda Zhang, Chi Yung Chung, Guangmin Zhou,* Jinpeng Tian* and Xuan Zhang*



7427

Near-cryogenic direct air capture using adsorbents

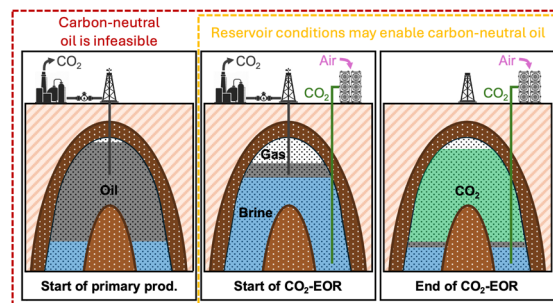
Seo-Yul Kim, Akriti Sarswat, Sunghyun Cho, MinGyu Song, Jinsu Kim, Matthew J. Realff, David S. Sholl and Ryan P. Lively*



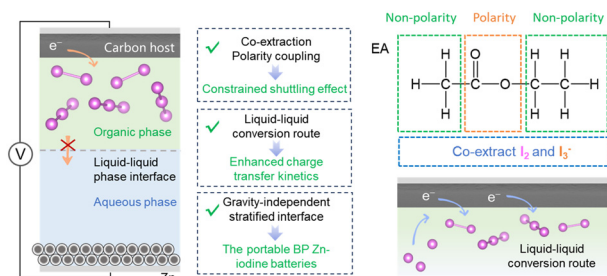
7440

Carbon footprint of oil produced through enhanced oil recovery using carbon dioxide directly captured from air

Antonio Gasós, Ronny Pini, Viola Becattini and Marco Mazzotti*



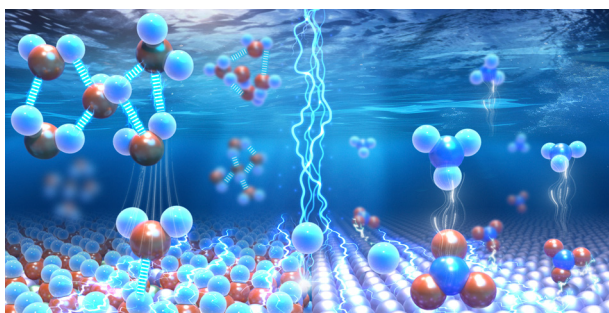
7447



Polarity coupling in biphasic electrolytes enables iodine/polyiodide co-extraction for portable Zn–iodine batteries following a liquid–liquid conversion route

Hai Xu, Ruanye Zhang, Derong Luo, Kangsheng Huang, Jiuqing Wang, Gengzhi Sun,* Hui Dou* and Xiaogang Zhang*

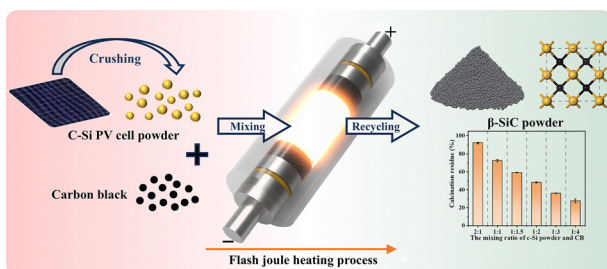
7460



Interfacial hydrogen-bond modulation of dynamic catalysts for nitrate electroreduction to ammonia

Yuchi Wan, Yixiang Tang, Yinze Zuo,* Kaian Sun, Zewen Zhuang, Yun Zheng, Wei Yan, Jiujun Zhang* and Ruitao Lv*

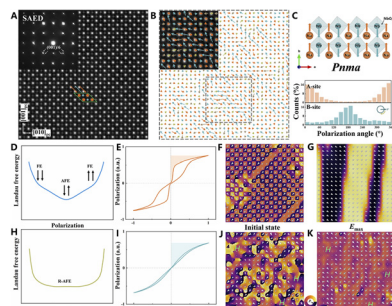
7470



Upcycling waste photovoltaic cells into silicon carbide via flash Joule heating

Ximing Zhang, Feihong Guo,* Xiaoxiang Jiang,* Abdullah H. Hamadamin, Adam F. Lee, Karen Wilson and Jabbar Gardy

7481



Nanoplex-driven energy storage in relaxor antiferroelectrics

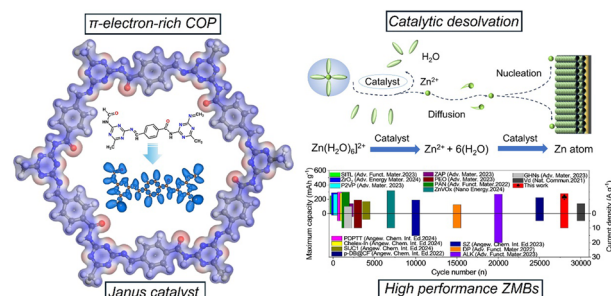
Simin Wang, Ke Xu, Guanglong Ge, Faqiang Zhang, Wangfeng Bai, Fei Yan, Jin Qian, Luomeng Tang, Yang Liu, Chao Sun, Zhongbin Pan, Bo Shen,* Zhifu Liu,* Houbing Huang* and Jiwei Zhai*



7490

Enhanced interfacial Zn^{2+} desolvation kinetics by a π -electron-rich Janus catalyst for robust Zn–metal batteries

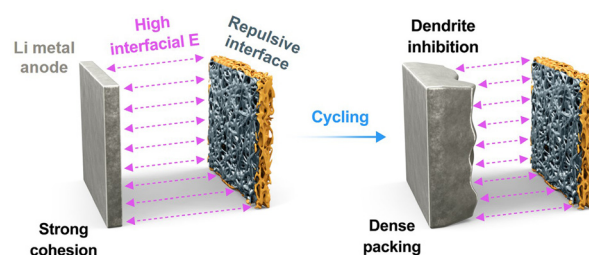
Yinze Zuo, Zheng Wang, Mingquan Liu,* Linlong Lu, Yidong Jiang, Jie Lei, Hao Yan, Hongwei Li, Wei Yan* and Jiujun Zhang*



7504

A repulsive anode interface for high-energy and safe lithium metal batteries

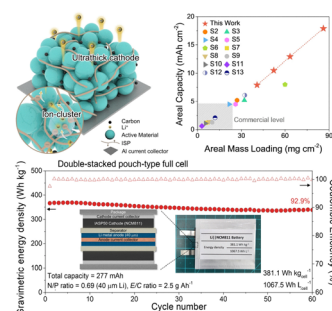
Jihoon Oh, Joseph L. Frank, Randolph A. Leising, Heejin Kim, Jisub Kim, Minkwan Kim and Jang Wook Choi*



7514

Regulating segmental dynamics for ion clusters in polymer binders to realize high-areal-capacity electrodes in lithium batteries

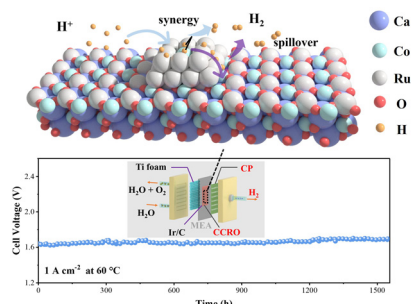
Dong-Yeob Han, Sungryong Kim, Yeongseok Kim, Haeryang Lim, Gyeong Rok Lee, Chi Keung Song, Woo-Jin Song, Hong Chul Moon,* Soojin Park* and Taiho Park*



7527

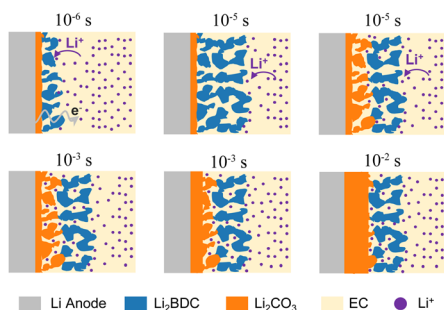
Self-assembled metal cluster/perovskite catalysts for efficient acidic hydrogen production with an ultra-low overpotential of 62 mV and over 1500 hours of stability at 1 A cm⁻²

Yalei Fan, Jianfa Zhao, Jing Zhou, Wei-Hsiang Huang, Jianqiu Zhu, Chang-Yang Kuo, Shengjie Zhang, Chih-Wen Pao, Ting-Shan Chan, Yuxuan Zhang, Su-Yang Hsu, Jin-Ming Chen, Chien-Te Chen, Changqing Jin, Liu Hao Tjeng, Jian-Qiang Wang,* Zhiwei Hu* and Linjuan Zhang*



PAPERS

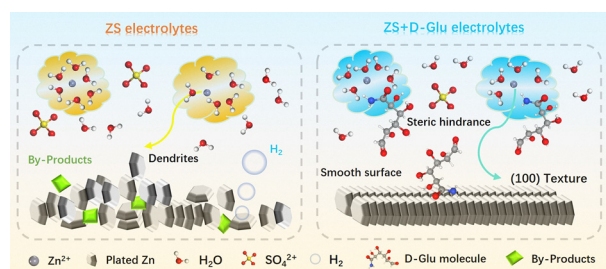
7541



Simulating solid electrolyte interphase formation spanning 10^8 time scales with an atomically informed phase-field model

Kena Zhang, Yanzhou Ji, Qisheng Wu, Seyed Amin Nabavizadeh, Yue Qi* and Long-Qing Chen*

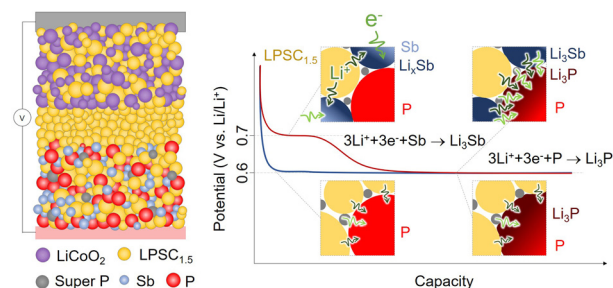
7555



Molecular engineering of D-glucuronamide additive directs (100)-oriented Zn deposition for ultra-stable zinc-ion batteries

Le Zhang, Shuyu Bi, Xijun Liu, Qiangchao Sun, Tao Hu, Xiongqiang Lu and Hongwei Cheng*

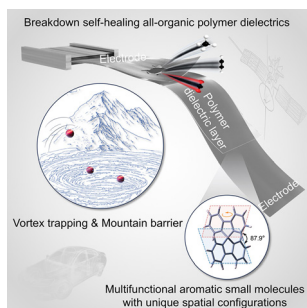
7568



All-solid-state batteries stabilized with electro-mechano-mediated phosphorus anodes

Kaier Shen, Xuhui Yao, Huimin Song, Weize Shi, Chenxi Zheng, Xufeng Hong, Yingjing Yan, Xu Liu, Lujun Zhu, Yun An, Tinglu Song, Muhammad Burhan Shafqat, Chenyan Ma, Lei Zheng, Peng Gao, Yakun Liu, Mohammadhosein Safari, Yunlong Zhao and Quanquan Pang*

7579



Nature-inspired synergistic strategy: carrier regulation in breakdown self-healing all-organic polymer dielectrics for enhanced high-temperature energy storage

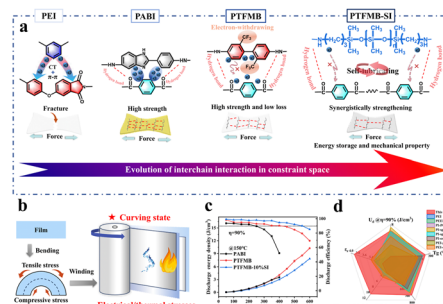
Wenjie Huang, Baoquan Wan, Wenye Zhang, Xing Yang, Zhonghua Xiang, Haobo Tian, Can Ding, Yiyi Zhang, Yong Chae Jung and Jun-Wei Zha*



7589

All-organic siloxane-strengthening polymer dielectrics for high-temperature capacitive energy storage in harsh-environment electronics

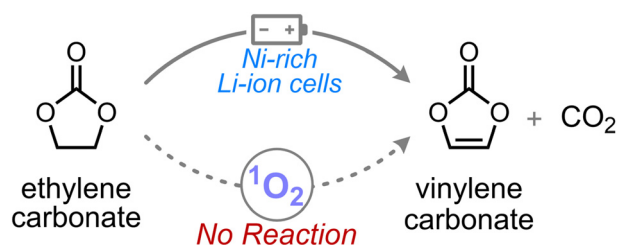
Xiang Li, Kun Fan,* Jingyi He, Siyuan Sun, Yinan Chai, Zhi-Min Dang and Xiangyang Liu*



7603

Singlet oxygen is not the source of ethylene carbonate degradation in nickel-rich Li-ion cells

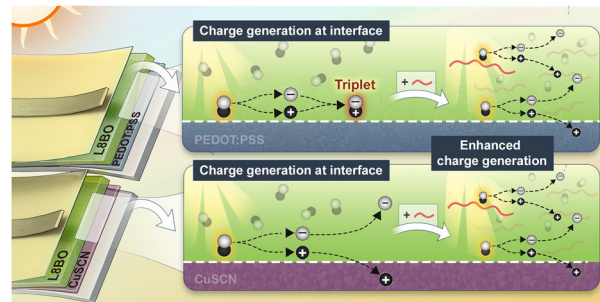
Rory C. McNulty, Kieran D. Jones, Benjamin M. G. Denison, Elizabeth Hampson, Israel Temprano, Darren A. Walsh, Hon Wai Lam, Graham N. Newton, Wesley M. Dose, Clare P. Grey and Lee R. Johnson*



7610

Elucidating the role of heterojunction in pristine non-fullerene acceptor organic solar cells

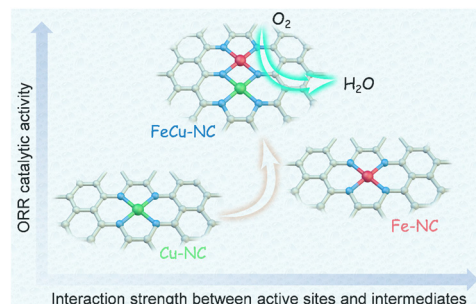
Anirudh Sharma,* Julien Gorenflot, Han Xu, José P. Jurado, Shahidul Alam, Diego Rosas Villalva, Xun Pan, Jules Bertrandie, Prem D. Nayak, Yakun He, Maryam Alqurashi, Ying Luo, Mats R. Andersson, Oskar J. Sandberg, Frederic Laquai and Derya Baran*



7624

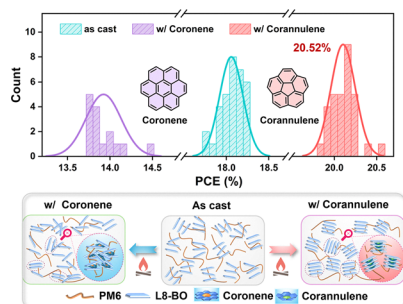
Interatomic Fe–Cu cooperation in nitrogen-doped carbon for enhanced oxygen reduction

Xiang Ao, Linfeng Li, Yong Ding, Gyutae Nam, Bote Zhao,* Chundong Wang* and Meilin Liu*



PAPERS

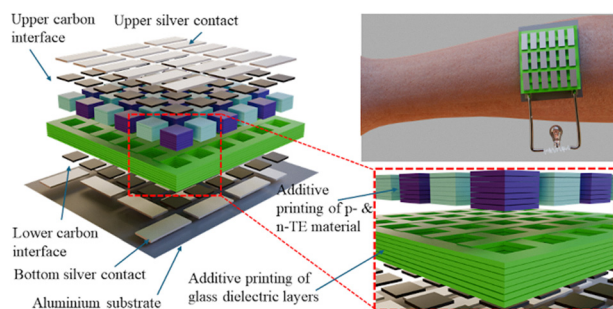
7635



Three-dimensional bowl-shaped solid additive achieves 20.52% efficiency organic solar cells with enhanced thermal stability via curvature-mediated morphology regulation

Zhicheng Zhong, Sergio Gámez-Valenzuela, Jin-Woo Lee, Yufei Wang, Bolin Li, Guanshui Xie, Weijie Zhou, Changjing Xu, Dingqin Hu, Haihui Cai, Qing Lian, Longbin Qiu, Guangye Zhang, Mingwei An,* Yang Wang, Bumjoon J. Kim, Xugang Guo* and Bin Liu*

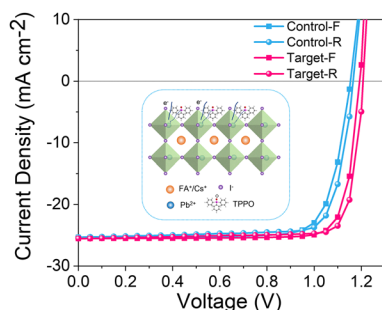
7648



Milliwatt-scale 3D thermoelectric generators via additive screen printing

Sairam Antharam, Muhammad Irfan Khan, Leonard Franke, Zirui Wang, Nan Luo, Jan Feßler, Wenjie Xie, Uli Lemmer* and Md Mofasser Mallick*

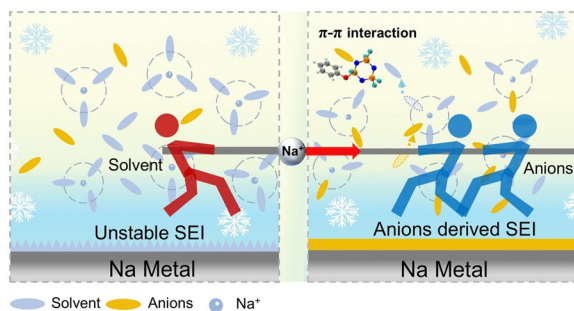
7660



Anchoring ligand engineering enables highly stable MA-free perovskite solar cells with a minimal V_{OC} deficit of 0.32 V

Chaohui Li,* Andrej Vincze, Hyoungwon Park, Fabian Streller, Klaus Götz, Shudi Qiu, Jiwon Byun, Ying Shang, Zhangyu Yuan, Lirong Dong, Jingjing Tian, Zijian Peng, Chao Liu, Fu Yang, Yanxue Wang, Andreas Späth, Andres Osvet, Karen Forberich, Thomas Heumueller, Silke H. Christiansen, Marcus Halik, Rainer H. Fink, Tobias Unruh, Ning Li, Larry Luer* and Christoph J. Brabec*

7669



Manipulating anion solvation competitiveness via a multifunctional additive toward robust low-temperature sodium metal batteries

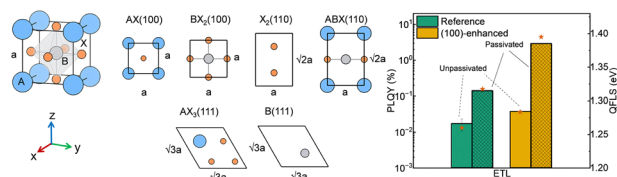
Tonghui Zhang, Ying Xiao,* Shunshun Zhao, Yu Han, Gang He and Shimou Chen*



7680

Exposing binding-favourable facets of perovskites for tandem solar cells

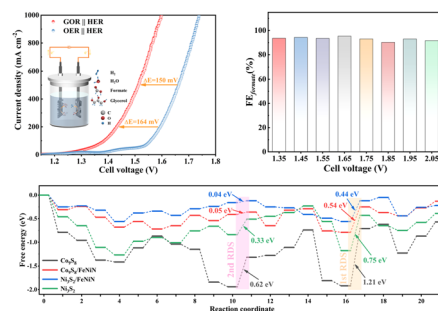
Junke Wang,* Shuaifeng Hu, Zehua Chen, Zhongcheng Yuan, Pei Zhao, Akash Dasgupta, Fengning Yang, Jin Yao, Minh Anh Truong, Gunnar Kusch, Esther Y-H. Hung, Nick R. M. Schipper, Laura Bellini, Guus J. W. Aalbers, Zonghao Liu, Rachel A. Oliver, Atsushi Wakamiya, René A. J. Janssen and Henry J. Snaith*



7695

Visualizing dynamic competitive reconstruction of trimetallic hybrid catalysts for stable hybrid water electrolysis at large current density

Yong Zhang, Liling Liao, Haiqing Zhou,* Ying Qi, Jingying Sun, Yan Zhang,* Qian Zhou, Yu Wang, Dongsheng Tang and Fang Yu*



7708

Non-linear spin correlation of intermediates in enhanced electrochemical nitrate reduction under magnetic fields

Dongsheng Shao, Qian Wu, Yuwei Zhang, Xiyang Cai, Chencheng Dai, Siyuan Zhu, Fanxu Meng, Pengfei Song, Xiaoning Li, Xiaoming Ren, Tianze Wu* and Zhichuan J. Xu*

