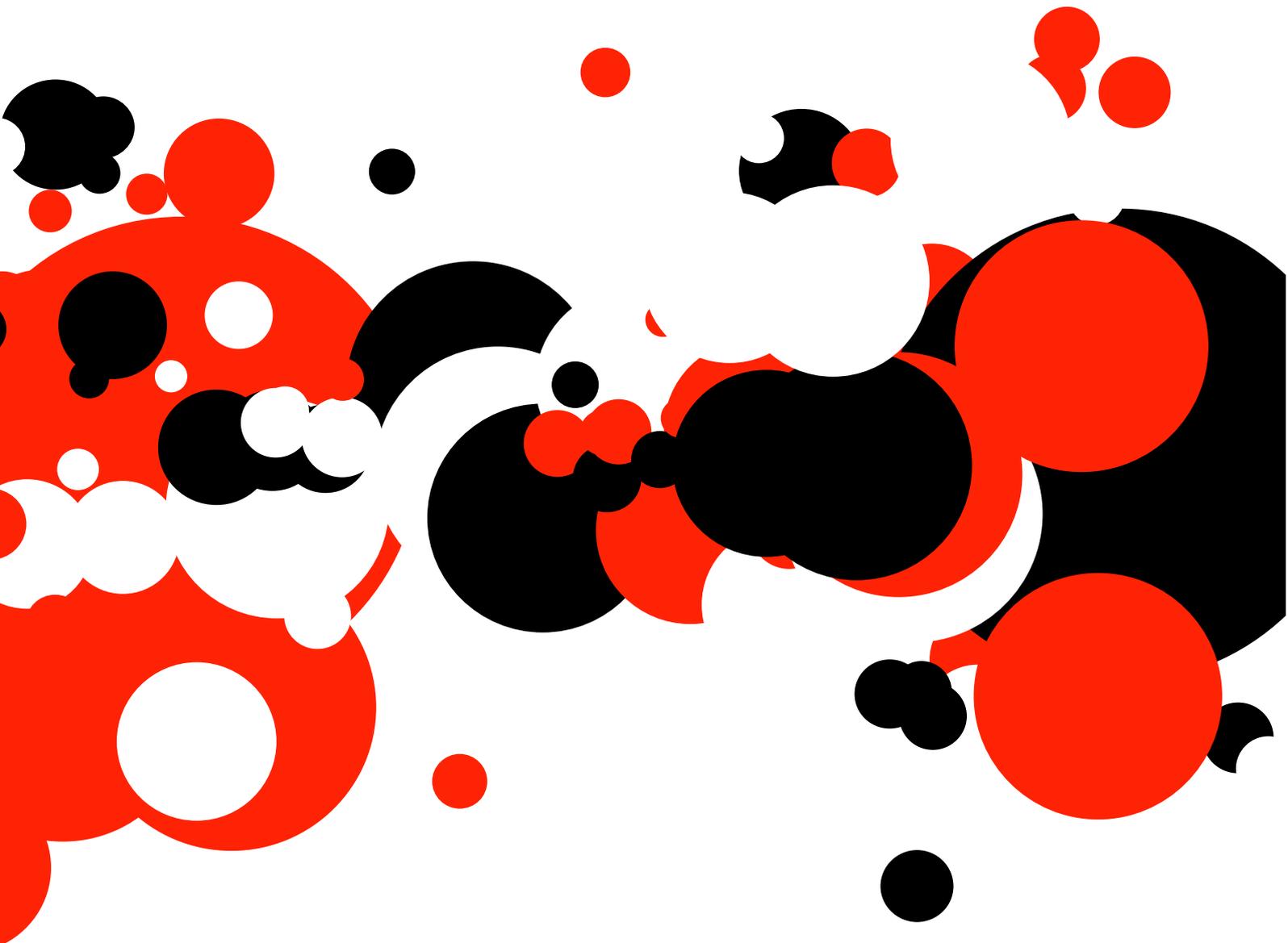




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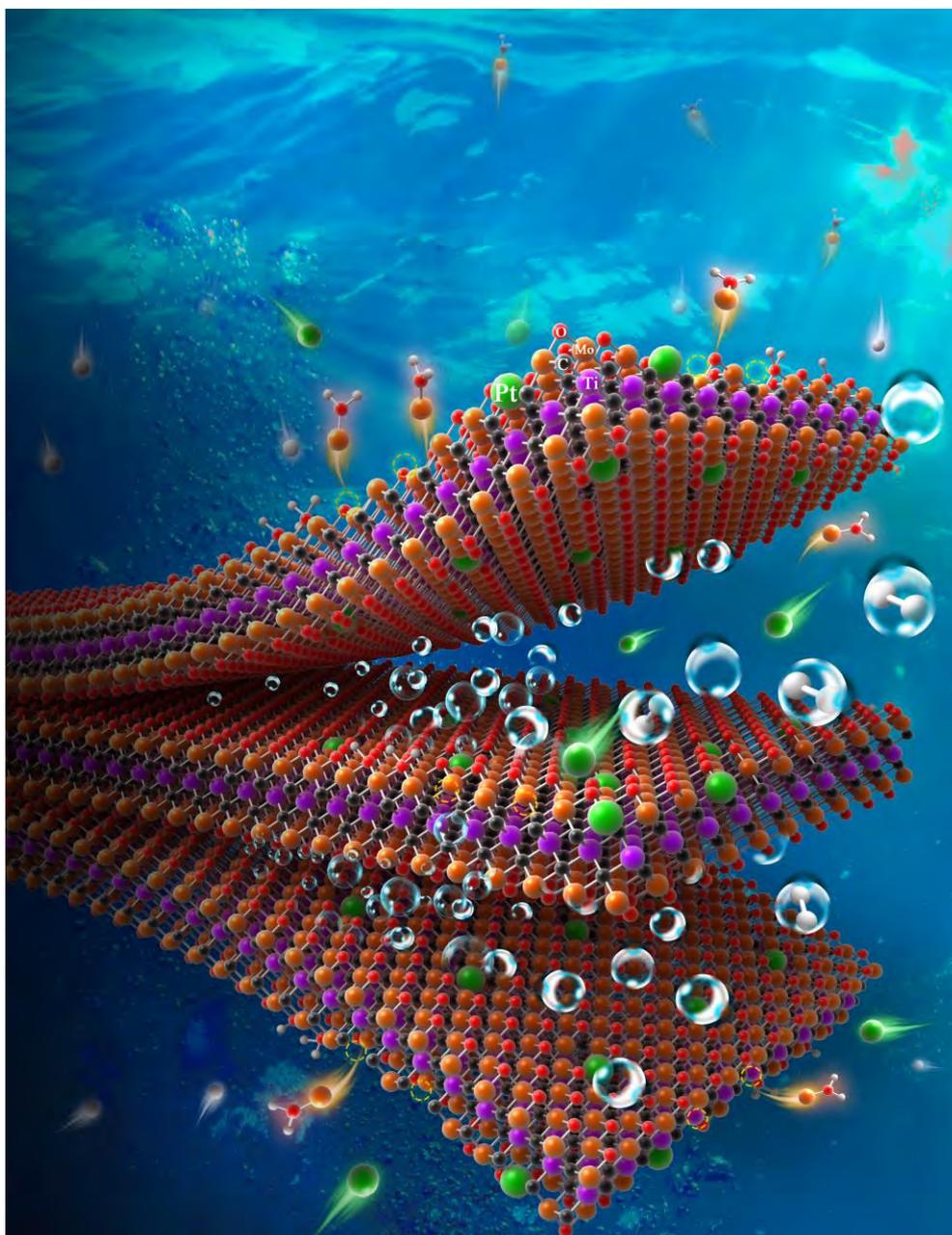
Research Highlights in 2018



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1. Jinqiang Zhang, Yufei Zhao, Xin Guo, Chen Chen, Chung-Li Dong, Ru-Shi Liu, Chih-Pin Han, Yadong Li, Yury Gogotsi, **Guoxiu Wang**, “Single platinum atoms immobilized on an MXene as an efficient catalyst for the hydrogen evolution reaction”, **Nature Catalysis** **1** (2018) 985 - 992.

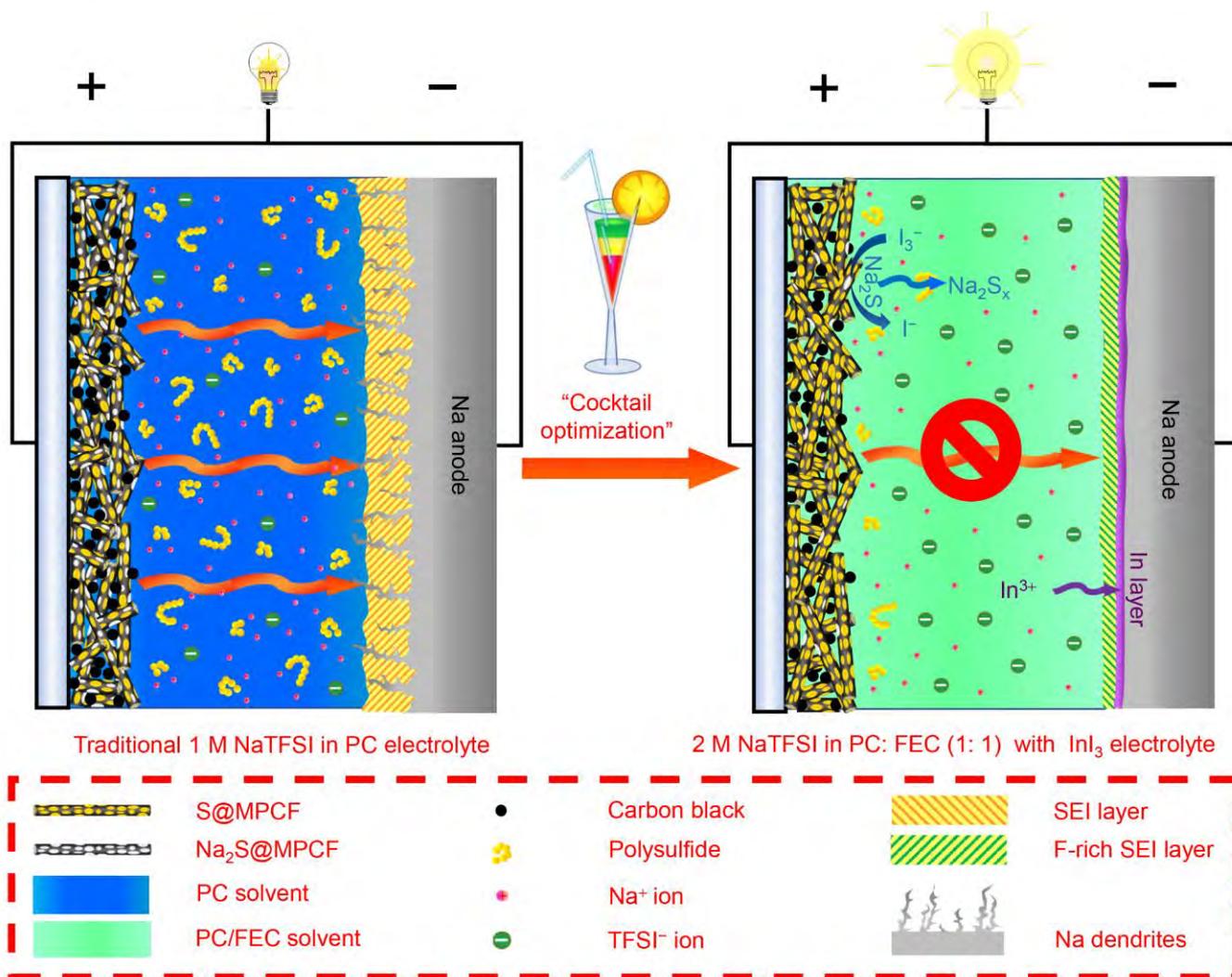
Abstract: Single-atom catalysts offer a pathway to cost-efficient catalysis using the minimal amount of precious metals. However, preparing and keeping them stable during operation remains a challenge. Here we report the synthesis of double transition metal MXene nanosheets-Mo₂TiC₂T_x, with abundant exposed basal planes and Mo vacancies in the outer layers-by electrochemical exfoliation, enabled by the interaction between protons and the surface functional groups of Mo₂TiC₂T_x. The as-formed Mo vacancies are used to immobilize single Pt atoms, enhancing the MXene’s catalytic activity for the hydrogen evolution reaction. The developed catalyst exhibits a high catalytic ability with low overpotentials of 30 and 77 mV to achieve 10 and 100 mA cm⁻² and a mass activity about 40 times greater than the commercial platinum-on-carbon catalyst. The strong covalent interactions between positively charged Pt single atoms and the MXene contribute to the exceptional catalytic performance and stability.



<https://www.nature.com/articles/s41929-018-0195-1>

2. Xiaofu Xu, Dong Zhou, Xianying Qin, Kui Lin, Feiyu Kang, Baohua Li, Devaraj Shanmukaraj, Teofilo Rojo, Michel Armand, **Guoxiu Wang**, “A room-temperature sodium-sulfur battery with high capacity and stable cycling performance”, **Nature Communications** 9 (2018) 3870. **IF= 12.353**

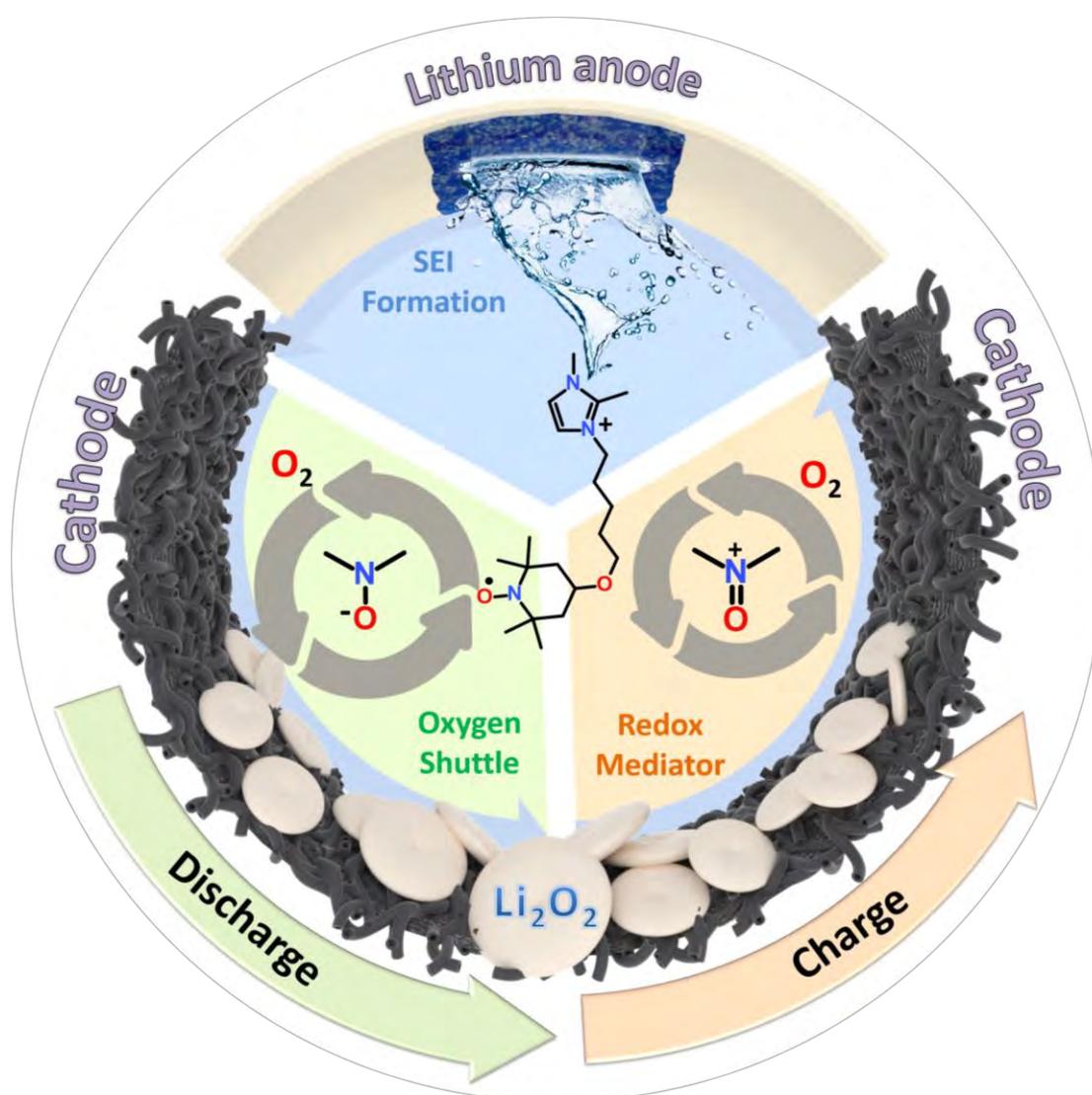
Abstract: High-temperature sodium-sulfur batteries operating at 300–350 °C have been commercially applied for large-scale energy storage and conversion. However, the safety concerns greatly inhibit their widespread adoption. Herein, we report a room-temperature sodium-sulfur battery with high electrochemical performances and enhanced safety by employing a “cocktail optimized” electrolyte system, containing propylene carbonate and fluoroethylene carbonate as co-solvents, highly concentrated sodium salt, and indium triiodide as an additive. As verified by first-principle calculation and experimental characterization, the fluoroethylene carbonate solvent and high salt concentration not only dramatically reduce the solubility of sodium polysulfides, but also construct a robust solid-electrolyte interface on the sodium anode upon cycling. Indium triiodide as redox mediator simultaneously increases the kinetic transformation of sodium sulfide on the cathode and forms a passivating indium layer on the anode to prevent it from polysulfide corrosion. The as-developed sodium-sulfur batteries deliver high capacity and long cycling stability.



<https://www.nature.com/articles/s41467-018-06443-3>

3. Jinqiang Zhang, Bing Sun, Yufei Zhao, Anastasia Tkacheva, Zhenjie Liu, Kang Yan, Xin Guo, Andrew M. McDonagh, Devaraj Shanmukaraj, Chengyin Wang, Teofilo Rojo, Michel Armand, Zhangquan Peng, **Guoxiu Wang**, “A versatile functionalized ionic liquid to comprehensively boost the solution-mediated performances of Li-O₂ batteries”, **Nature Communications**. 10 (2019) 602. **IF= 12.353**

Abstract: Due to the high theoretical specific energy, the lithium–oxygen battery has been heralded as a promising energy storage system for applications such as electric vehicles. However, its large over-potentials during discharge–charge cycling lead to the formation of side-products, and short cycle life. Herein, we report an ionic liquid bearing the redox active 2,2,6,6-tetramethyl-1-piperidinyloxy moiety, which serves multiple functions as redox mediator, oxygen shuttle, lithium anode protector, as well as electrolyte solvent. The additive contributes a 33-fold increase of the discharge capacity in comparison to a pure ether-based electrolyte and lowers the over-potential to an exceptionally low value of 0.9 V. Meanwhile, its molecule facilitates smooth lithium plating/stripping, and promotes the formation of a stable solid electrolyte interface to suppress side-reactions. Moreover, the proportion of ionic liquid in the electrolyte influences the reaction mechanism, and a high proportion leads to the formation of amorphous lithium peroxide and a long cycling life (> 200 cycles). In particular, it enables an outstanding electrochemical performance when operated in air.



<https://www.nature.com/articles/s41467-019-08422-8>

4. Bing Sun, Peng Li, Jinqiang Zhang, Dan Wang, Paul Munroe, Chengyin Wang, Peter H. L. Notten, **Guoxiu Wang**, “Dendrite-Free Sodium-Metal Anodes for High-Energy Sodium-Metal Batteries”, *Advanced Materials* 30 (2018) 1801334. IF= 21.950

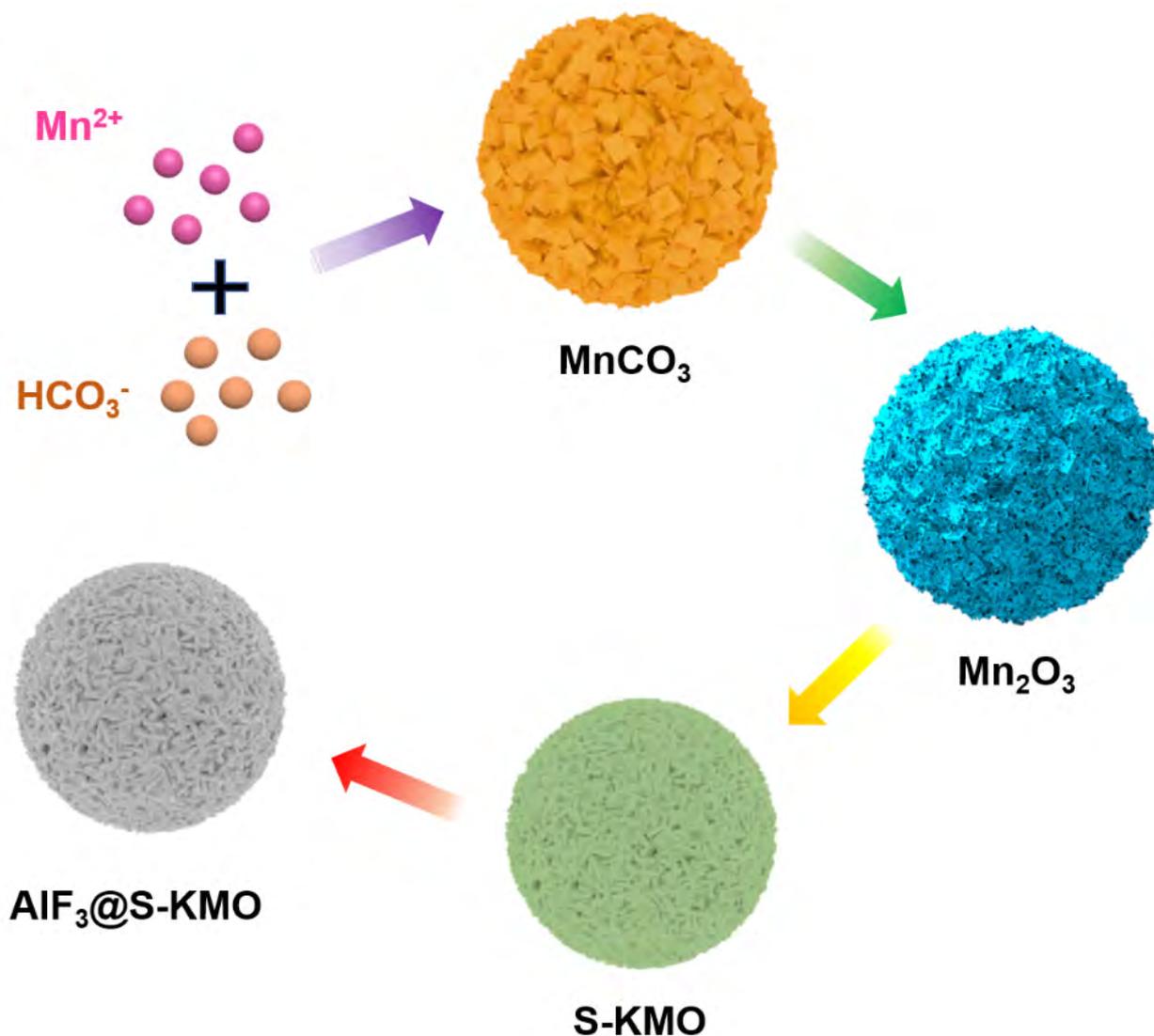
Abstract: Sodium (Na) metal is one of the most promising electrode materials for next-generation low-cost rechargeable batteries. However, the challenges caused by dendrite growth on Na metal anodes restrict practical applications of rechargeable Na metal batteries. Herein, a nitrogen and sulfur co-doped carbon nanotube (NSCNT) paper is used as the interlayer to control Na nucleation behavior and suppress the Na dendrite growth. The N- and S- containing functional groups on the carbon nanotubes induce the NSCNTs to be highly “sodiophilic,” which can guide the initial Na nucleation and direct Na to distribute uniformly on the NSCNT paper. As a result, the Na - metal - based anode (Na/NSCNT anode) exhibits a dendrite - free morphology during repeated Na plating and stripping and excellent cycling stability. As a proof of concept, it is also demonstrated that the electrochemical performance of sodium-oxygen (Na-O₂) batteries using the Na/NSCNT anodes show significantly improved cycling performances compared with Na-O₂ batteries with bare Na metal anodes. This work opens a new avenue for the development of next-generation high-energy-density sodium-metal batteries.



<https://onlinelibrary.wiley.com/doi/abs/10.1002/adma.201801334>

5. Shuoqing Zhao, Kang Yan, Paul Munroe, Bing Sun, Guoxiu Wang, "Construction of Hierarchical $K_{1.39}Mn_3O_6$ Spheres via AlF_3 Coating for High-Performance Potassium-Ion Batteries", **Advanced Energy Materials**, (doi.org/10.1002/aenm.201803757) **IF=21.875**.

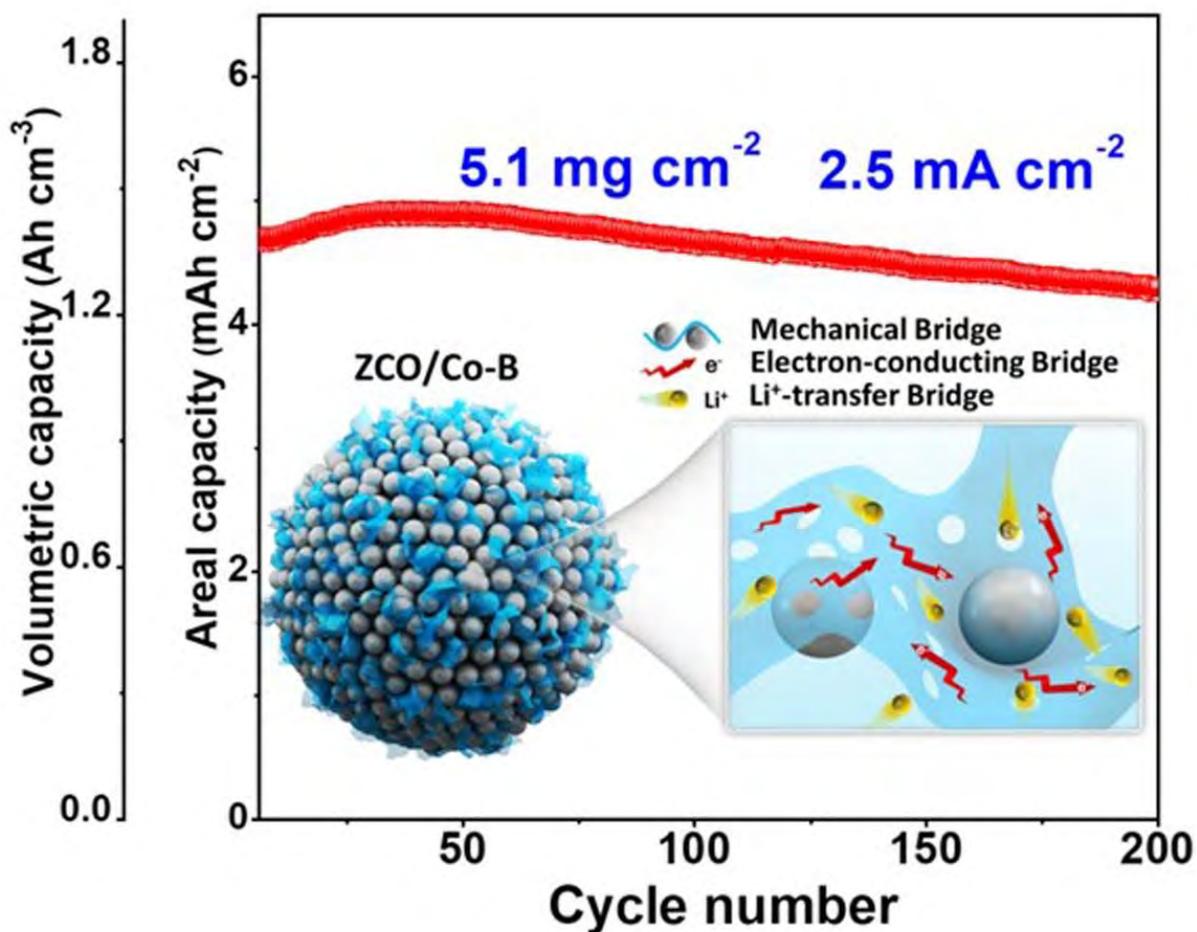
Abstract: Potassium-ion batteries are attracting great interest for emerging large - scale energy storage owing to their advantages such as low cost and high operational voltage. However, they are still suffering from poor cycling stability and sluggish thermodynamic kinetics, which inhibits their practical applications. Herein, the synthesis of hierarchical $K_{1.39}Mn_3O_6$ microspheres as cathode materials for potassium-ion batteries is reported. Additionally, an effective AlF_3 surface coating strategy is applied to further improve the electrochemical performance of $K_{1.39}Mn_3O_6$ microspheres. The as-synthesized AlF_3 coated $K_{1.39}Mn_3O_6$ microspheres show a high reversible capacity (about 110 mA h g^{-1} at 10 mA g^{-1}), excellent rate capability, and cycling stability. Galvanostatic intermittent titration technique results demonstrate that the increased diffusion kinetics of potassium-ion insertion and extraction during discharge and charge processes benefit from both the hierarchical sphere structure and surface modification. Furthermore, ex situ X-ray diffraction measurements reveal that the irreversible structure evolution can be significantly mitigated via surface modification. This work sheds light on rational design of high-performance cathode materials for potassium-ion batteries.



<https://onlinelibrary.wiley.com/doi/abs/10.1002/aenm.201803757>

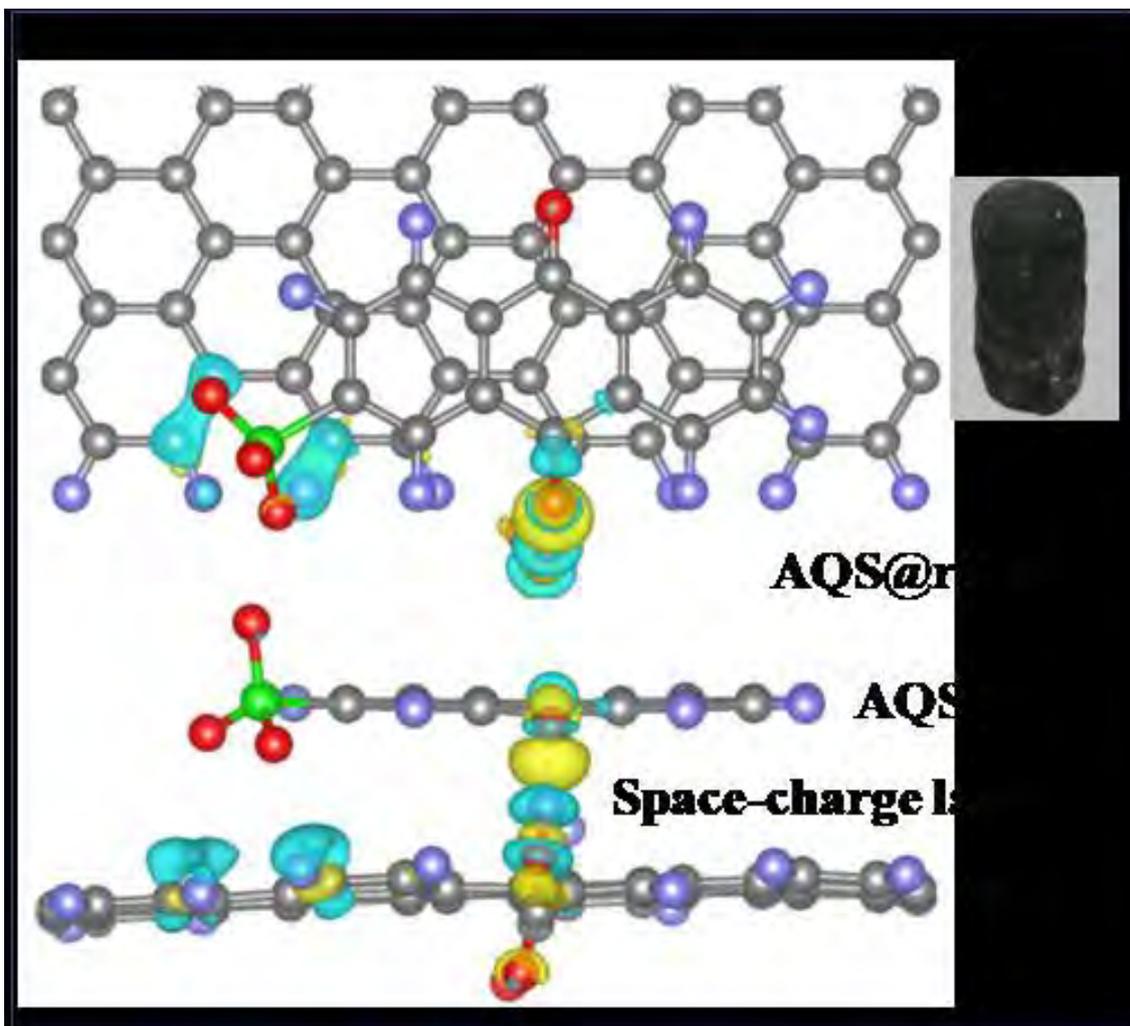
6. Jiaojiao Deng, Xiaoliang Yu, Xianying Qin, Dong Zhou, Lihan Zhang, Huan Duan, Feiyu Kang, Baohua Li*, **Guoxiu Wang***. Co-B nanoflakes as multi-functional bridges in ZnCo₂O₄ micro-/nanospheres for superior lithium storage with boosted kinetics and stability. **Advanced Energy Materials**, 2019, 10.1002/aenm.201803612.

Abstract: Transition metal oxides (TMO) hold great promise as high-energy anodes in next-generation lithium-ion batteries (LIBs). However, owing to the inherent limitations of low electronic/ionic conductivities and dramatic volume change during charge/discharge, it is still challenging to fabricate practically viable compact and thick TMO anodes with satisfactory electrochemical performances. Herein, with mesoporous cobalt-boride (Co-B) nanoflakes serving as multi-functional bridges in ZnCo₂O₄ micro-/nanospheres, a compact ZnCo₂O₄/Co-B hybrid structure has been constructed to fulfill the above requirements. Co-B nanoflakes not only bridge ZnCo₂O₄ nanoparticles and function as anchors in ZCO micro-/nanospheres to suppress the severe volume fluctuation, but also work as effective electron conduction bridges to promote fast electron transportation. More importantly, they serve as Li⁺ transfer bridges to provide significantly boosted Li⁺ diffusivity evidenced from both experimental kinetics analysis and DFT calculations. The mesopores within Co-B nanoflakes help overcome the large Li⁺ diffusion barriers across 2D interfaces. As a result, the ZnCo₂O₄/Co-B electrode delivers high gravimetric/volumetric/areal capacities of 995 mAh g⁻¹/1450 mAh cm⁻³/5.10 mAh cm⁻², respectively, with robust rate capability and long-term cyclability. Such distinct interfacial strategy provides a new direction on designing compact conversion-type anodes with superior lithium storage kinetics and stability towards practical applications.



7. Ruiying Shi, Cuiping Han, Huan Duan, Lei Xu, Dong Zhou, Hongfei Li, Junqin Li, Feiyu Kang, Baohua Li, **Guoxiu Wang**, "Redox-Active Organic Sodium Anthraquinone-2-Sulfonate (AQS) Anchored on Reduced Graphene Oxide for High-Performance Supercapacitors", **Advanced Energy Materials** 8 (2018) 1802088. **IF= 21.875**

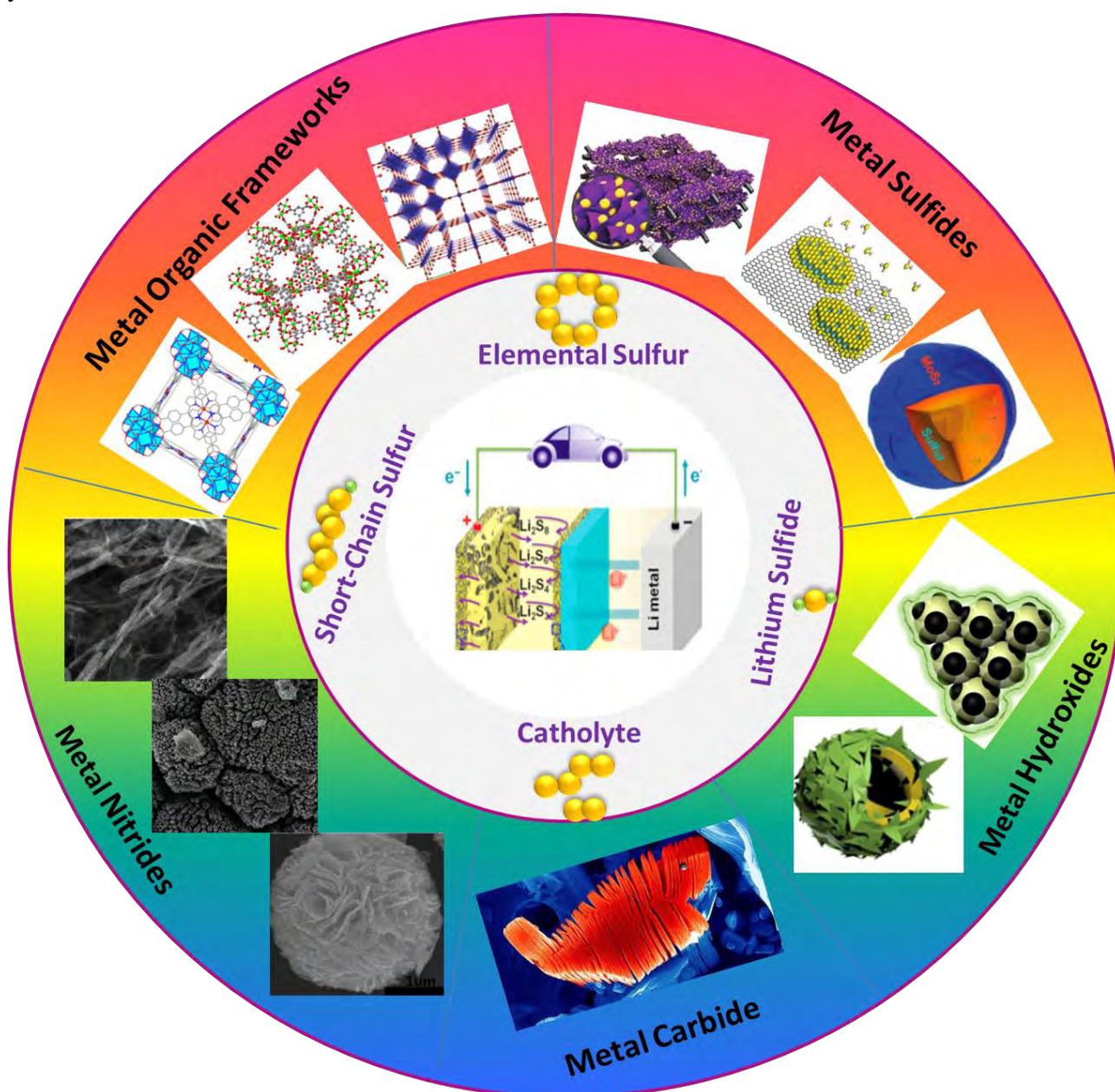
Abstract: Redox active organic quinones are potentially low cost, sustainable, and high-energy pseudocapacitive materials due to their fast and reversible redox reactivity. However, their electrically insulating nature prevents any practical application. Herein, for the first time, sodium anthraquinone-2-sulfonate (AQS) is examined as an organic redox-active compound and highly conductive graphene nanosheets are incorporated to enhance the electronic conductivity. The SO_3^- functional group of AQS offers excellent hydrophilicity, which promotes the molecular level binding of AQS with reduced graphene oxide (rGO) and leads to a 3D interconnected xerogel (AQS@rGO). The composite exhibits a high specific capacitance of 567.1 F g^{-1} at 1 A g^{-1} with a stable capacity retention of 89.1% over 10 000 cycles at 10 A g^{-1} . More importantly, the optimized composite maintains a high capacitance of 315.1 F g^{-1} even at 30 A g^{-1} due to the high pseudocapacitance of AQS and the capacitive contribution of rGO. First-principles calculations further elucidate that AQS offers strong adhesion to rGO sheets with the formation of a space-charge layer, which is favorable for the pseudocapacitance of AQS. This work opens a new avenue for developing high-performance supercapacitors through rational combination of redox organic molecules with highly conductive graphene.



<https://onlinelibrary.wiley.com/doi/abs/10.1002/aenm.201802088>

8. Jing Xu, Tom Lawson, Hongbo Fan, Dawei Su, **Guoxiu Wang**, "Updated Metal Compounds (MOFs, -S, -OH, -N, -C) Used as Cathode Materials for Lithium-Sulfur Batteries", **Advanced Energy Materials** 8 (2018) 1702607. **IF= 21.875**

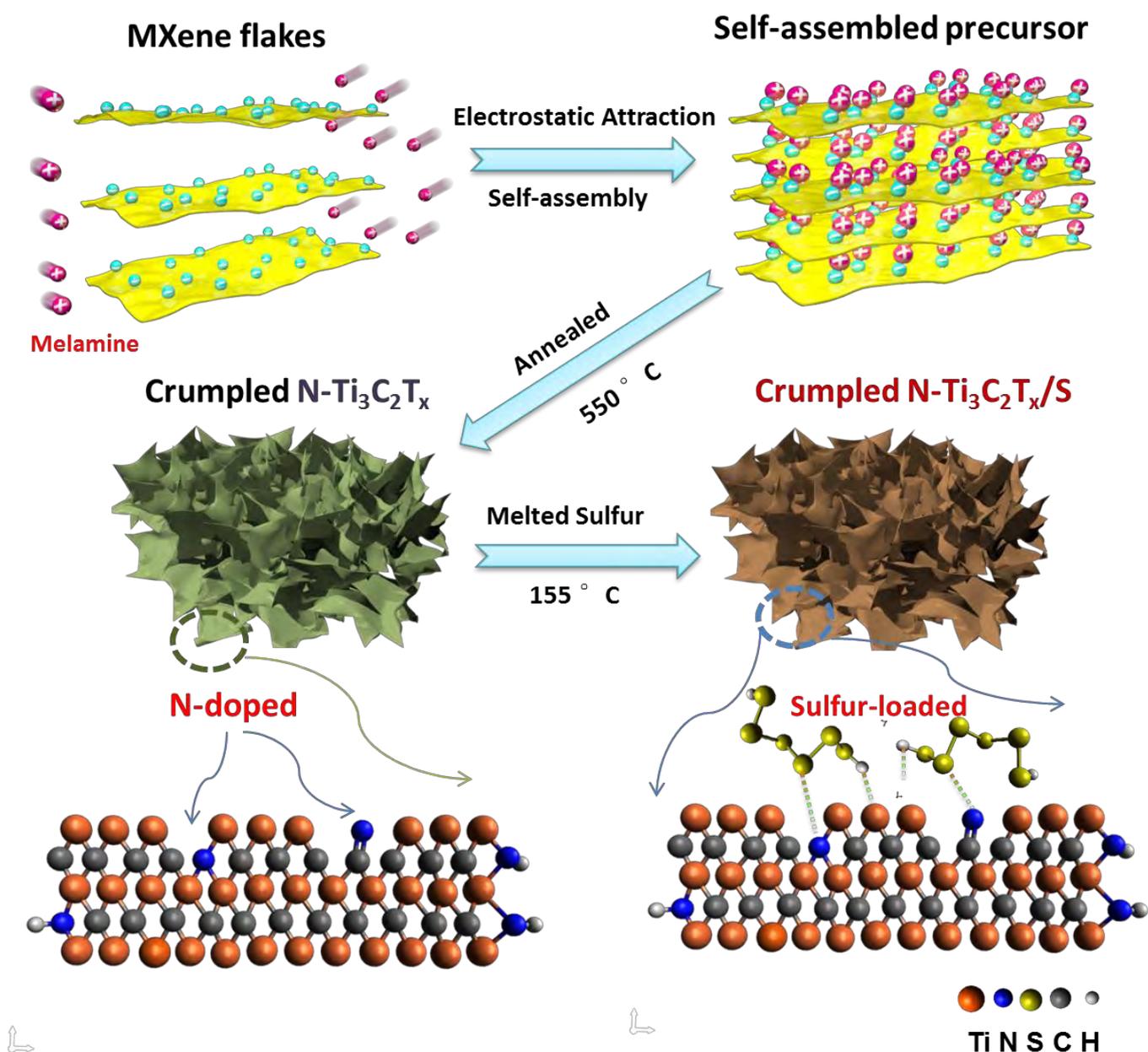
Abstract: Lithium-sulfur (Li-S) batteries have the potential to be as efficient and as widespread as lithium-ion (Li-ion) batteries, since sulfur electrode has high theoretical capacity ($1672 \text{ mA h g}_{\text{sul}}^{-1}$) and this element is affordable. However, unlike their ubiquitous lithium ion (Li-ion) counterparts, it is difficult to realize the commercialization of Li-S battery. Because the shuttle effect of polysulfide inevitably results in the serious capacity degradation. Tremendous progress is devoted to approach this problem from the aspect of physical confinement and chemisorption of polysulfide. Owing to weak intermolecular interactions, physical confinement strategy, however is not effective when the battery is cycled long-term. Chemisorption of polysulfide that derived from polar-polar interaction, Lewis acid-base interaction, and sulfur-chain catenation, are proven to significantly suppress the shuttle effect of polysulfide. It is also discovered that the metal compounds have strong chemical interactions with polysulfide. Therefore, this review focuses on latest metal-organic frameworks metal sulfides, metal hydroxides, metal nitrides, metal carbides, and discusses how the chemical interactions couple with the unique properties of these metal compounds to tackle the problem of polysulfide shuttle effect.



<https://onlinelibrary.wiley.com/doi/abs/10.1002/aenm.201702607>

9. Weizhai Bao, Lin Liu, Chengyin Wang, Sinho Choi, Dan Wang, **Guoxiu Wang**, “Facile Synthesis of Crumpled Nitrogen-Doped MXene Nanosheets as a New Sulfur Host for Lithium-Sulfur Batteries”, *Advanced Energy Materials* 8 (2018) 1702485. IF= 21.875

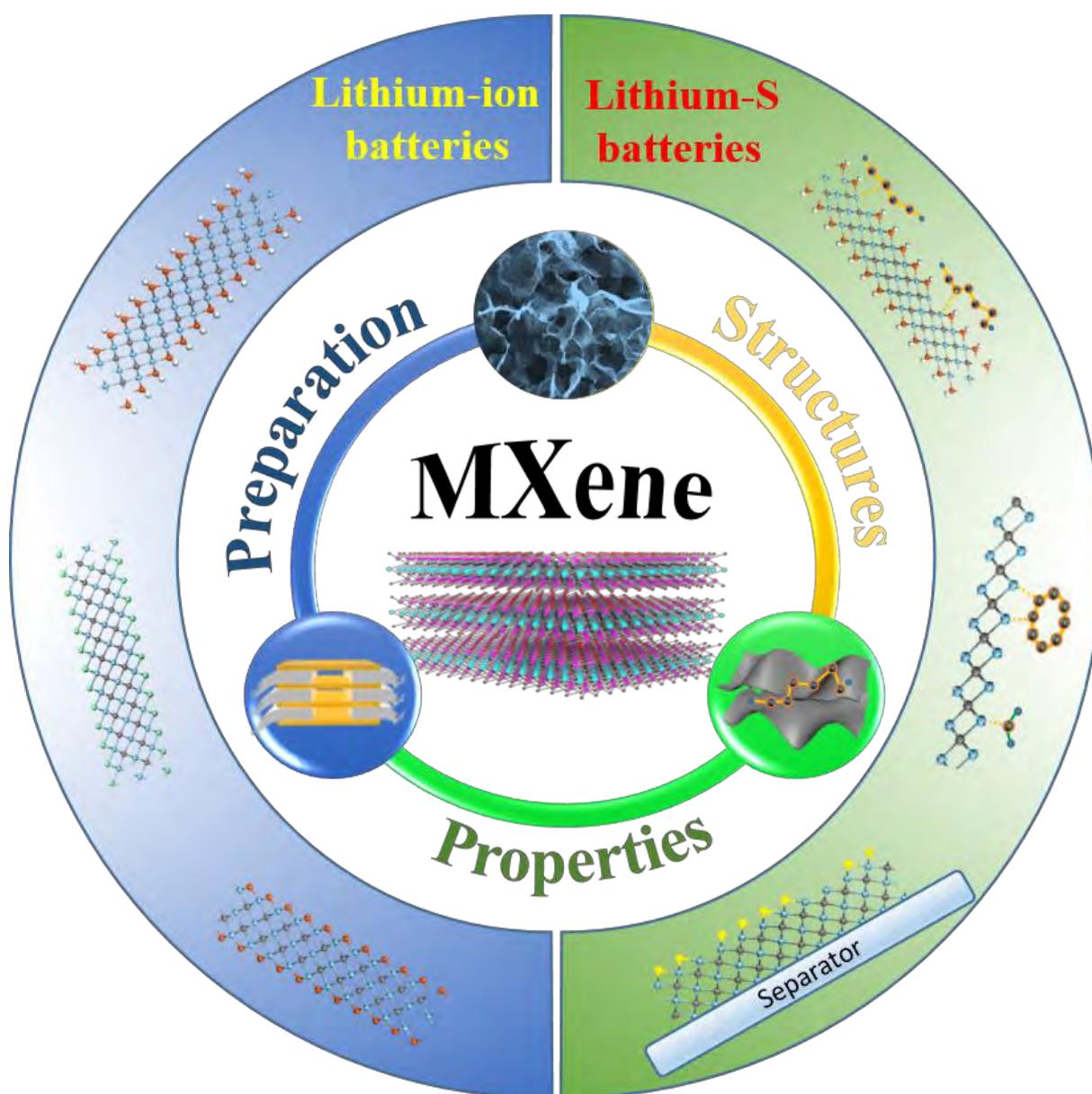
Abstract: Crumpled nitrogen-doped MXene nanosheets with strong physical and chemical coadsorption of polysulfides are synthesized by a novel one-step approach and then utilized as a new sulfur host for lithium-sulfur batteries. The nitrogen-doping strategy enables introduction of heteroatoms into MXene nanosheets and simultaneously induces a well-defined porous structure, high surface area, and large pore volume. The as-prepared nitrogen-doped MXene nanosheets have a strong capability of physical and chemical dual-adsorption for polysulfides and achieve a high areal sulfur loading of 5.1 mg cm^{-2} . Lithium-sulfur batteries, based on crumpled nitrogen-doped MXene nanosheets/sulfur composites, demonstrate outstanding electrochemical performances, including a high reversible capacity (1144 mA h g^{-1} at 0.2C rate) and an extended cycling stability (610 mA h g^{-1} at 2C after 1000 cycles).



<https://onlinelibrary.wiley.com/doi/abs/10.1002/aenm.201702485>

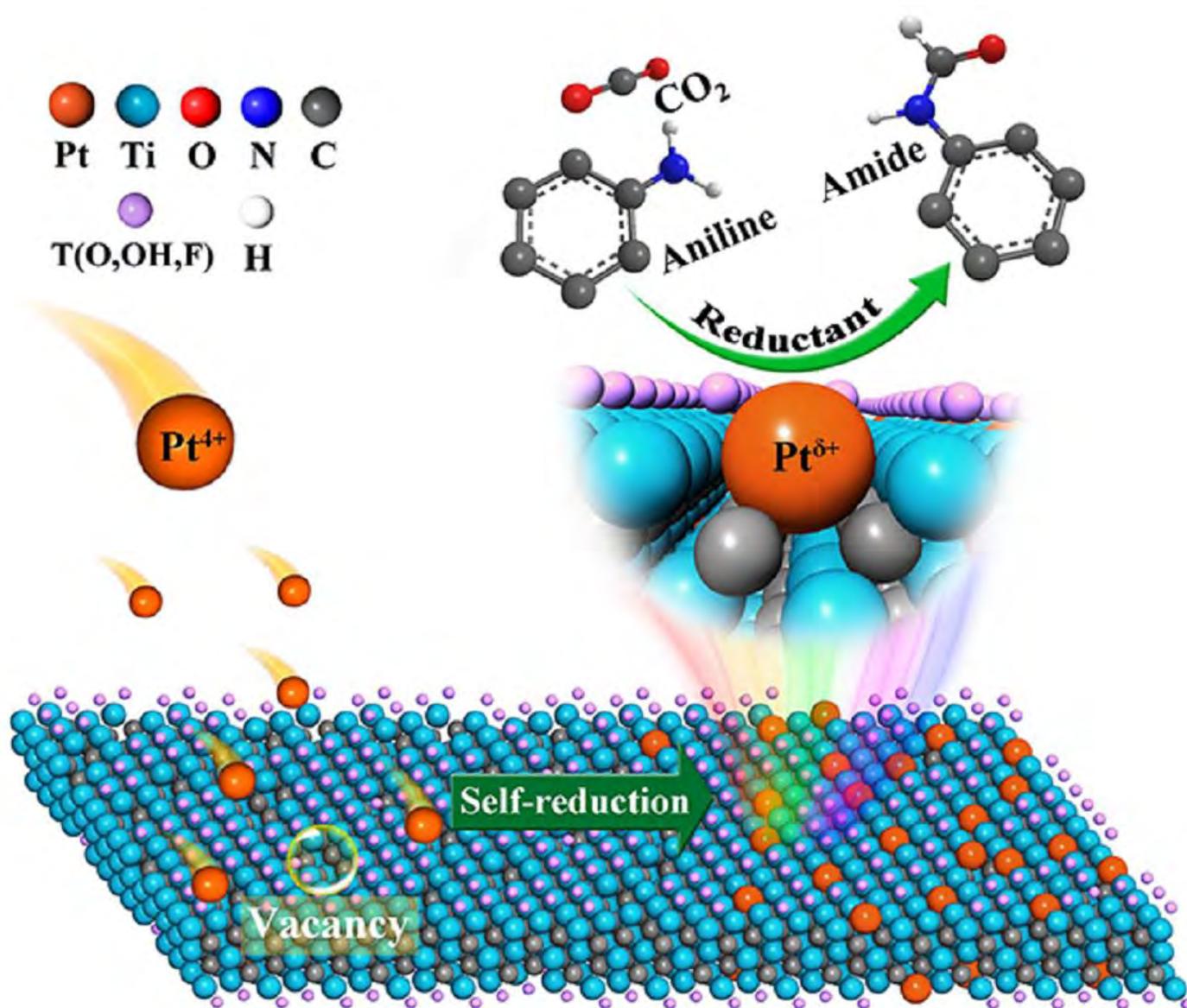
10. Xiao Tang, Xin Guo, Wenjian Wu, **Guoxiu Wang**, “2D Metal Carbides and Nitrides (MXenes) as High - Performance Electrode Materials for Lithium-Based Batteries”, **Advanced Energy Materials** 8 (2018) 1801897. **IF= 21.875**

Abstract: Tremendous efforts are devoted to developing advanced electrode materials with superior electrochemical performance, high energy density, and high power density for energy storage and conversion. Two-dimensional (2D) materials, owing to their unique properties, have shown great potential for energy storage. Following the discovery of graphene, a new family of 2D transition metal carbides/nitrides, MXenes, derived from MAX phase precursors, have attracted extensive attention in recent years. The superior physical and chemical properties of MXenes include high mechanical strength, excellent electrical conductivity, multiple possible surface terminations, hydrophilic features, superior specific surface area, and the ability to accommodate intercalants. When applied as electrodes in lithium-based batteries, MXenes have demonstrated excellent performance. In this progress report, the authors summarize the recent advances of MXenes and MXene-based composites in terms of synthesis strategies, morphology engineering, physical/chemical properties, and their applications in lithium-ion batteries and lithium-sulfur batteries. Furthermore, challenges and perspectives for MXenes and MXene-based composites for lithium-based energy storage devices are also outlined.



11. Di Zhao, Zheng Chen, Wenjuan Yang, Shoujie Liu, Xun Zhang, Yi Yu, Weng-Chon Cheong, Lirong Zheng, Fuqiang Ren, Guobing Ying, Xing Cao, Dingsheng Wang, Qing Peng, **Guoxiu Wang**, and Chen Chen, "MXene (Ti_3C_2) Vacancy Confined Single-Atom Catalyst for Efficient Functionalization of CO_2 ", *J. Am. Chem. Soc.* (DOI:10.1021/jacs.8b13579). **IF=14.357**

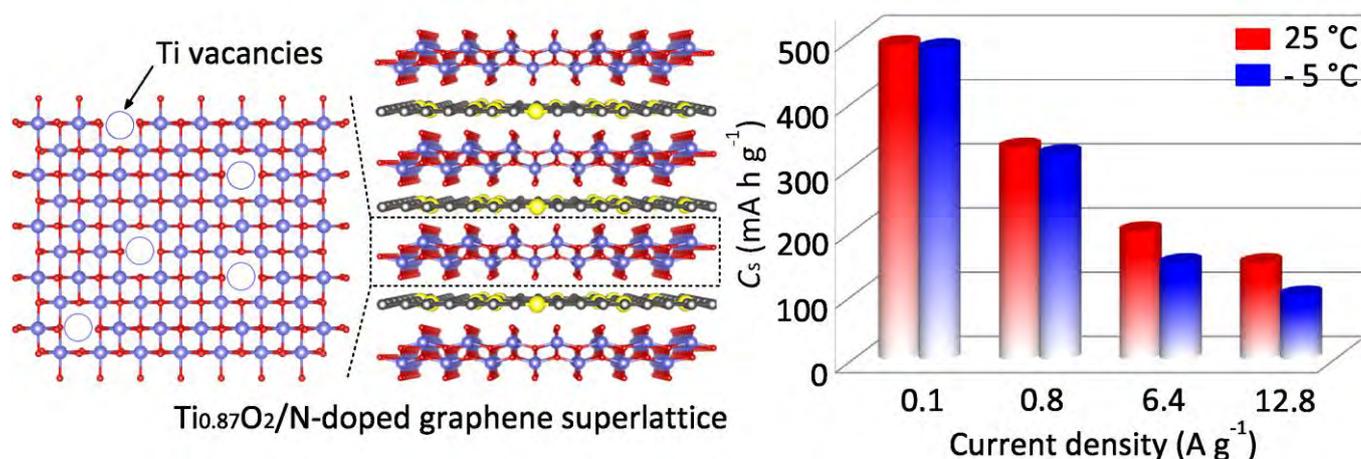
Abstract: A central topic in single atom catalysis is to build strong interactions between single atoms and the support for stabilization. Herein we report the preparation of stabilized single atom catalysts via a simultaneous self-reduction-stabilization process under room-temperature using ultrathin two-dimensional $\text{Ti}_{3-x}\text{C}_2\text{Ty}$ MXene nanosheets characterized by abundant Ti-deficit vacancy defects and high reducing capability. The single atoms therein form strong metal-carbon bonds with the $\text{Ti}_{3-x}\text{C}_2\text{Ty}$ support, and are therefore stabilized onto the sites previously occupied by Ti. The Pt-based single atom catalyst (SAC) $\text{Pt}/\text{Ti}_{3-x}\text{C}_2\text{Ty}$ offers a green route to utilize the greenhouse gas CO_2 , via formylation of amines, as a C1 source in organic synthesis. DFT calculations reveal that, compared to Pt nanoparticles, the single Pt atoms on $\text{Ti}_{3-x}\text{C}_2\text{Ty}$ support feature partial positive charges and atomic dispersion, which helps to significantly decrease the adsorption energy and activation energy of silane, CO_2 and aniline, thereby boosting catalytic performance. We believe that these results would open up new opportunities for the fabrication of SACs and the applications of MXenes in organic synthesis.



<https://pubs.acs.org/doi/10.1021/jacs.8b13579>

12. Pan Xiong, Xiuyun Zhang, Fan Zhang, Ding Yi, Jinqiang Zhang, Bing Sun, Huajun Tian, Devaraj Shanmukaraj, Teofilo Rojo, Michel Armand, Renzhi Ma, Takayoshi Sasaki, **Guoxiu Wang**, “Two-Dimensional Unilamellar Cation-Deficient Metal Oxide Nanosheet Superlattices for High-Rate Sodium Ion Energy Storage”, *ACS Nano*, 12 (2018) 12337-12346. **IF= 13.709**

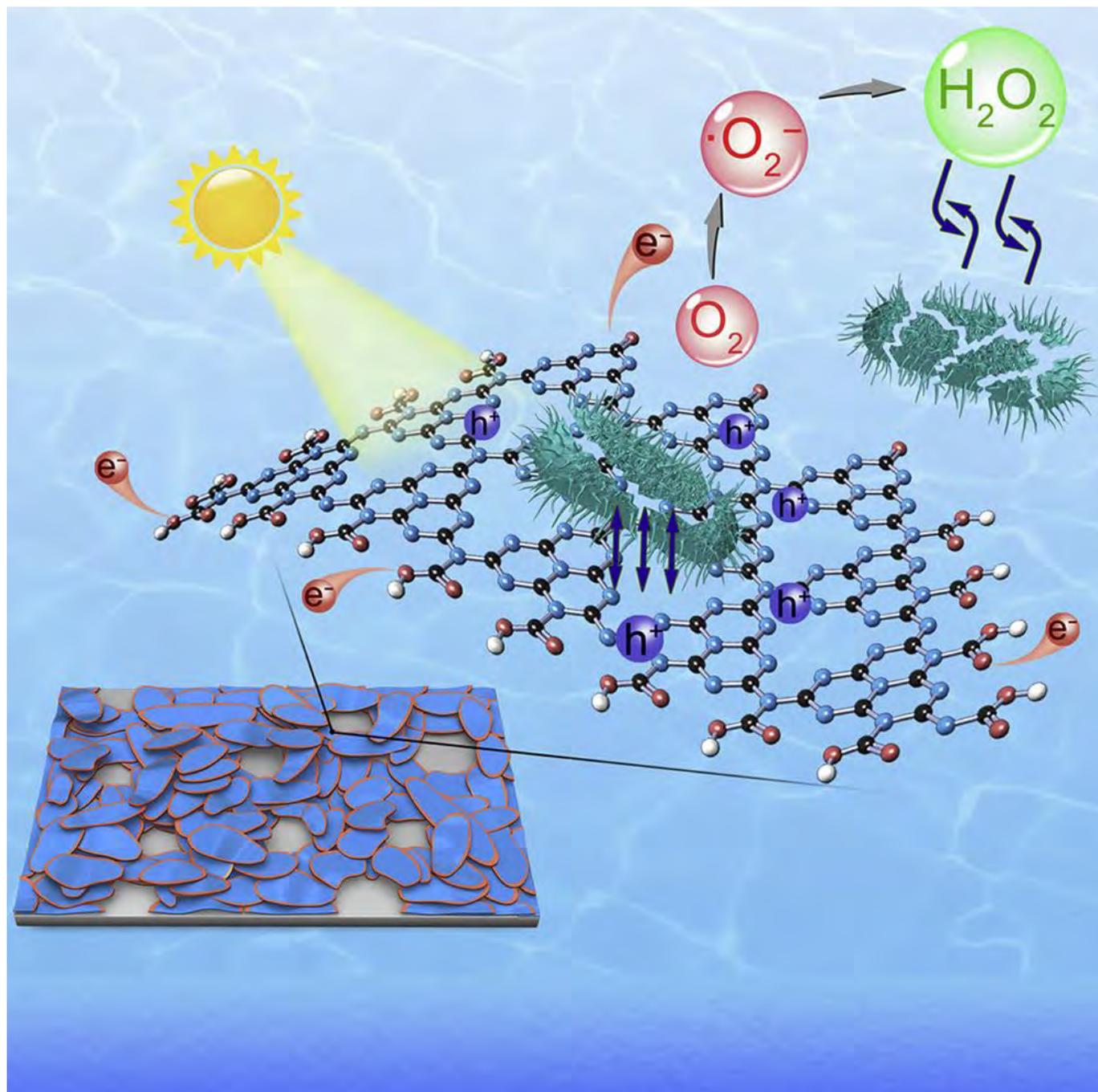
Abstract: Cation-deficient two-dimensional (2D) materials, especially atomically thin nanosheets, are highly promising electrode materials for electrochemical energy storage that undergo metal ion insertion reactions, yet they have rarely been achieved thus far. Here, we report a Ti-deficient 2D unilamellar lepidocrocite-type titanium oxide ($\text{Ti}_{0.87}\text{O}_2$) nanosheet superlattice for sodium storage. The superlattice composed of alternately restacked defective $\text{Ti}_{0.87}\text{O}_2$ and nitrogen-doped graphene monolayers exhibits an outstanding capacity of $\sim 490 \text{ mA h g}^{-1}$ at 0.1 A g^{-1} , an ultralong cycle life of more than 10000 cycles with $\sim 0.00058\%$ capacity decay per cycle, and especially superior low-temperature performance (100 mA h g^{-1} at 12.8 A g^{-1} and -5°C), presenting the best reported performance to date. A reversible Na^+ ion intercalation mechanism without phase and structural change is verified by first-principles calculations and kinetics analysis. These results herald a promising strategy to utilize defective 2D materials for advanced energy storage applications.



<https://pubs.acs.org/doi/abs/10.1021/acsnano.8b06206>

13. Zhenyuan Teng, Nailiang Yang, Hongying L, Chengyin Wang, Dan Wang, **Guoxiu Wang**, “Edge-Functionalized g-C₃N₄ Nanosheets as a Highly Efficient Metal-free Photocatalyst for Safe Drinking Water”, **Chem** (doi.org/10.1016/j.chempr.2018.12.009). **IF= 14.104**

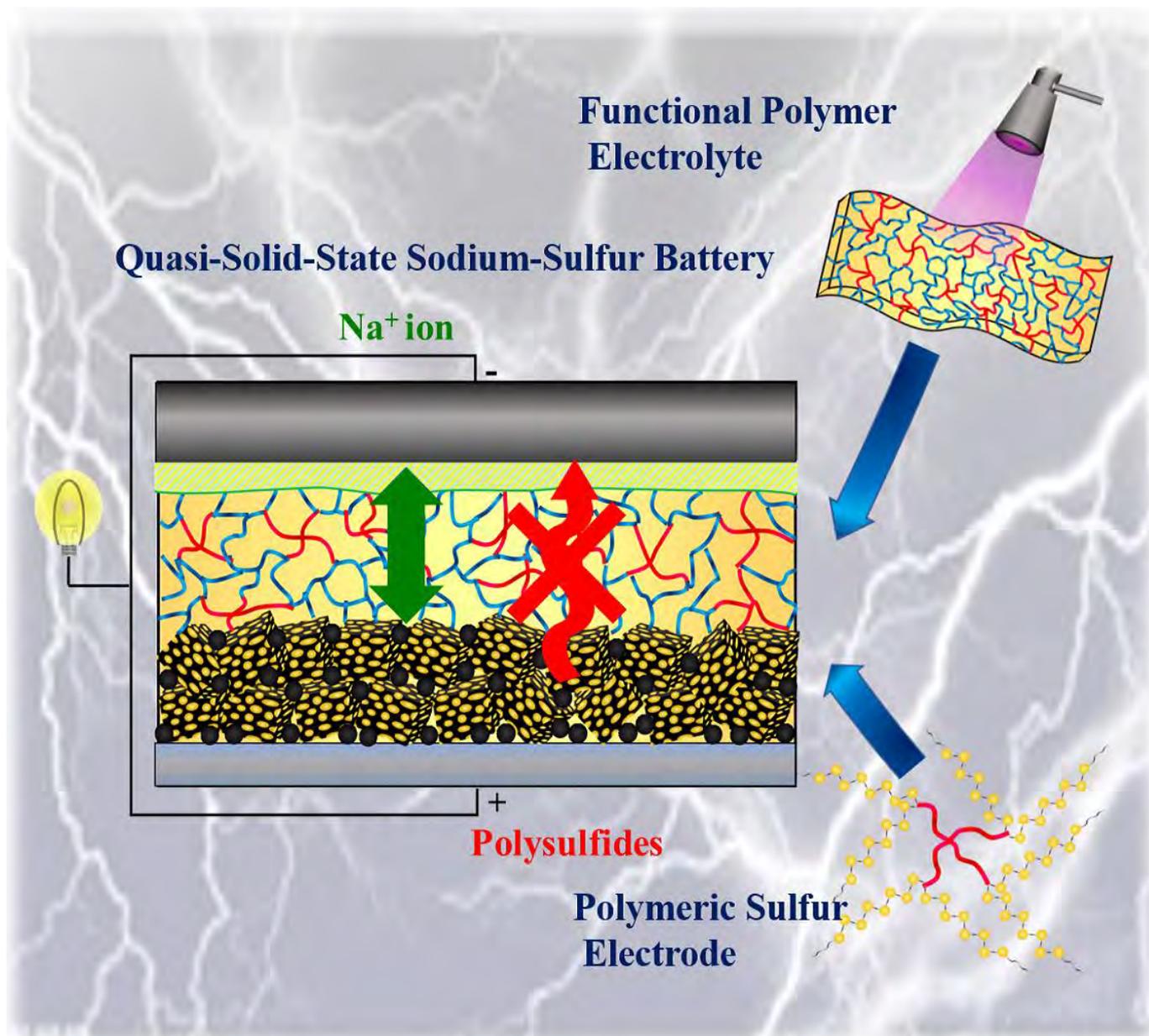
Abstract: Discovering highly efficient metal-free catalysts for photocatalytic disinfection will be greatly beneficial for the alleviation of the issues of clean water scarcity and global energy shortage. In addition, secondary pollution resulting from the use of metal-based catalysts can be avoided. In our work, we prepared the edge-functionalized g-C₃N₄ by selectively introducing electron-withdrawing groups at the edges of g-C₃N₄ nanosheets by using a facile wet-chemical method. Among all the metal-free photocatalysts currently used in the disinfection of model *Escherichia coli* under visible-light irradiation, this method reaches a record efficiency. Notably, this edge functionalization generates an anisotropic built-in electric field that promotes the separation of photo-generated electron-hole pairs. This work provides a new strategy for controlling surface charge density, which could lead to the discovery of additional unique properties and promising applications in catalysis, electronics, and targeted therapy.



<https://www.sciencedirect.com/science/article/pii/S2451929418305722#abs0025>

14. Dong Zhou, Yi Chen, Baohua Li, Hongbo Fan, Faliang Cheng, Devaraj Shanmukaraj, Teofilo Rojo, Michel Armand, **Guoxiu Wang**, "A Stable Quasi-Solid-State Sodium-Sulfur Battery", **Angewandte Chemie International Edition** 57 (2018) 10168-10172. IF= 12.102

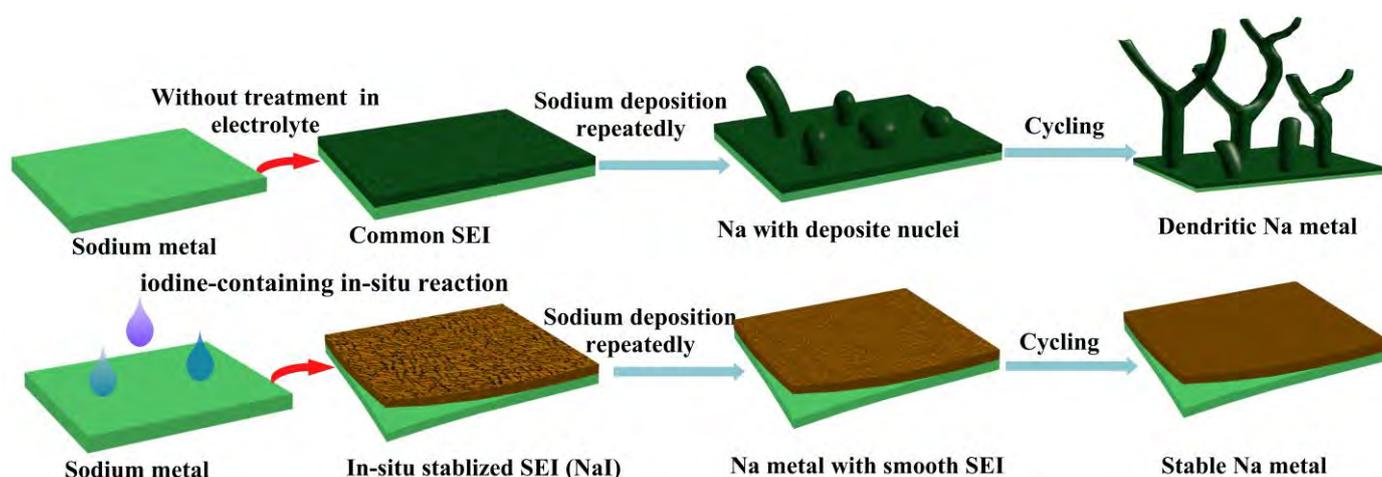
Abstract: Ambient-temperature sodium-sulfur (Na-S) batteries are considered a promising energy storage system due to their high theoretical energy density and low costs. However, great challenges remain in achieving a high rechargeable capacity and long cycle life. Herein we report a stable quasi-solid-state Na-S battery enabled by a poly(S-pentaerythritol tetraacrylate (PETEA))-based cathode and a (PETEA-tris[2-(acryloyloxy)ethyl] isocyanurate (THEICTA))-based gel polymer electrolyte. The polymeric sulfur electrode strongly anchors sulfur through chemical binding and inhibits the shuttle effect. Meanwhile, the in situ formed polymer electrolyte with high ionic conductivity and enhanced safety successfully stabilizes the Na anode/electrolyte interface, and simultaneously immobilizes soluble Na polysulfides. The as-developed quasi-solid-state Na-S cells exhibit a high reversible capacity of 877 mA h g⁻¹ at 0.1 C and an extended cycling stability.



<https://onlinelibrary.wiley.com/doi/abs/10.1002/anie.201805008>

15. Huajun Tian, Hezhu Shao, Yi Chen, Xiaqin Fang, Pan Xiong, Bing Sun, Peter H. L. Notten, **Guoxiu Wang**, Ultra-stable Sodium Metal-iodine Batteries Enabled by An In-situ Solid Electrolyte Interphase, *Nano Energy*, 57 (2019) 692-702 IF= 13.120

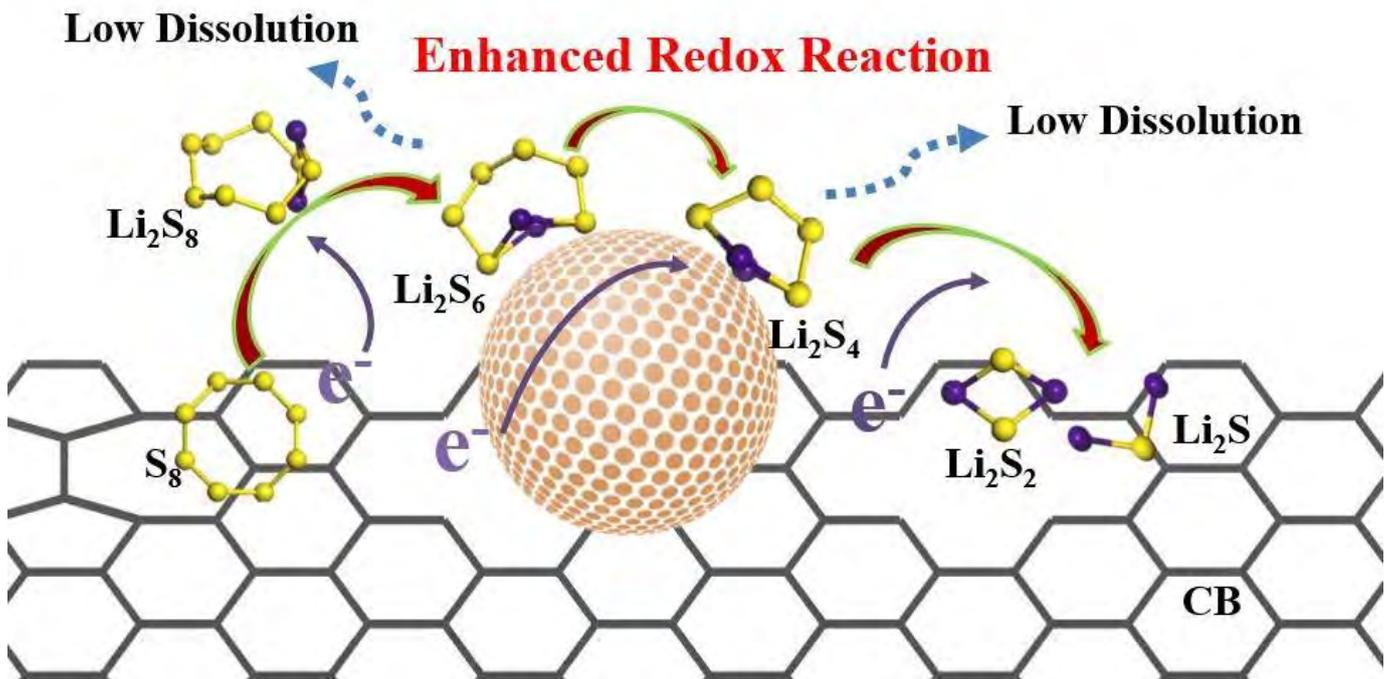
Abstract: High capacity sodium (Na) metal anodes open up new opportunities for developing next-generation rechargeable batteries with both high power and high energy densities. However, many challenges still plagued their practical application, including low plating/stripping Coulombic efficiency (CE) and dendrite growth after repeated cycle inducing safety issue. Especially, the sodium metal is less stable in organic (i.e. carbonate-based) electrolytes than lithium metal, due to the more unstable organic solid–electrolyte interface (SEI). Herein, we report a facile technology to stabilize sodium metal anode and inhibit the growth of sodium dendrites. The in-situ ultrathin NaI SEI layer successfully endows best-performance Na/I₂ metal batteries (>2200 cycles) with high capacity (210 mA h g⁻¹ at 0.5 C) based on the conversion reaction chemistry with higher discharge voltage plateau (> 2.7 V) and lower overpotential (134 mV) due to the fast charge transfer dynamics and interfacial stability compared with pristine Na anode. The detailed theoretical calculations and experimental results elucidate that NaI layer has a much lower diffusion barrier compared to that of NaF (NaF as one the most commonly found inorganic components in Na-based SEI layer), and actually facilitates more uniform sodium deposition. This work provides a new avenue for designing low-cost, high-performance and high-safety sodium metal-iodine batteries and other metal-iodine batteries.



<https://www.sciencedirect.com/science/article/pii/S2211285518309972#ab0010>

16. Jing Xu, Wenxue Zhang, Hongbo Fan, Faliang Cheng, Dawei Su, **Guoxiu Wang**, “Promoting Lithium Polysulfide/sulfide Redox Kinetics by the Catalyzing of Zinc Sulfide for High Performance Lithium-Sulfur Battery”, **Nano Energy** 51 (2018) 73-82. **IF= 13.120**

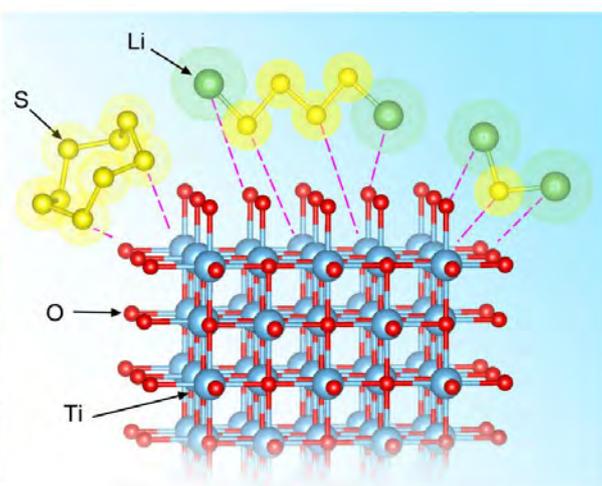
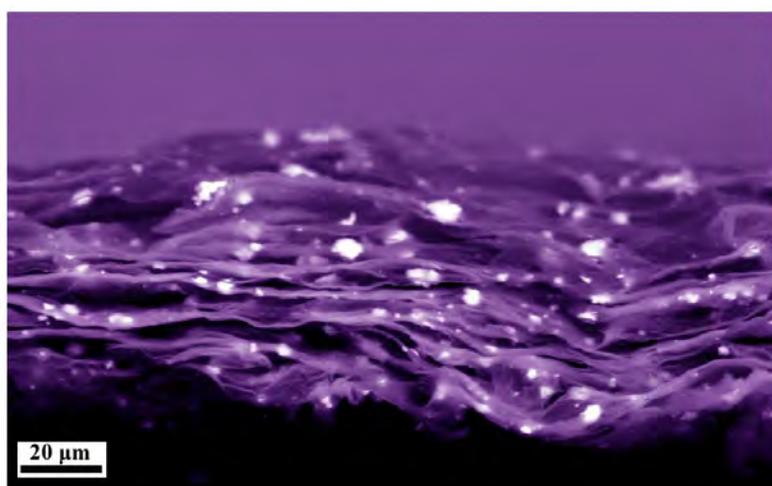
Abstract: Entrapping polysulfide from dissolution into electrolyte by strong chemisorption of polar materials has been widely reported in lithium-sulfur (Li-S) battery. Here, for the first time, zinc sulfide (ZnS) was demonstrated as an activation catalyst in Li-S battery to suppress the soluble polysulfide shuttle effect by powering kinetics redox reactions of lithium polysulfide/sulfide. Kinetic analyses comprehensively identify that ZnS not only facilitates polysulfide redox kinetics in liquid phase ($\text{Li}_2\text{S}_8 \rightarrow \text{Li}_2\text{S}_6 \rightarrow \text{Li}_2\text{S}_4$), but also promotes the effective decompositions of lithium sulfide (Li_2S). Furthermore, first-principle calculations confirm that the low lithium ion diffusion barrier on the surface of ZnS promotes the redox reaction between lithium ion and sulfur species; and the low migration energy barrier of polysulfide on its surface guarantees the fast diffusion of polysulfides from the ZnS surface to the nearby conductive substrate, thus effectively smoothes polysulfides' entrapping-diffusion-conversion mechanism across the ZnS interface, resulting in the highly reversible electrochemical performance. As evidenced by the ex situ SEM and visible experiment, the reaction between migrated sulfur species and lithium anode was significantly alleviated, and the insulating $\text{Li}_2\text{S}/\text{Li}_2\text{S}_2$ was uniformly deposited on the ZnS-CB/S cathode. This ZnS cathode based Li-S battery exhibits outstanding performance including an excellent retained discharge specific capacity of $589 \text{ mA h g}_{\text{sul}}^{-1}$ with the high sulfur loading of 7 mg cm^{-2} (200 cycles) and extended cycling stability at the high current rate of 2 C, 5 C ($632, 388 \text{ mA h g}_{\text{sul}}^{-1}$ after 1000 cycles).



<https://www.sciencedirect.com/science/article/pii/S2211285518304385>

17. Yi Chen, Sinho Choi, Dawei Su, Xiaochun Gao, **Guoxiu Wang**, “Self-standing sulfur cathodes enabled by 3D hierarchically porous titanium monoxide-graphene composite film for high-performance lithium-sulfur batteries”, *Nano Energy* 47 (2018) 331-339. **IF= 13.120**

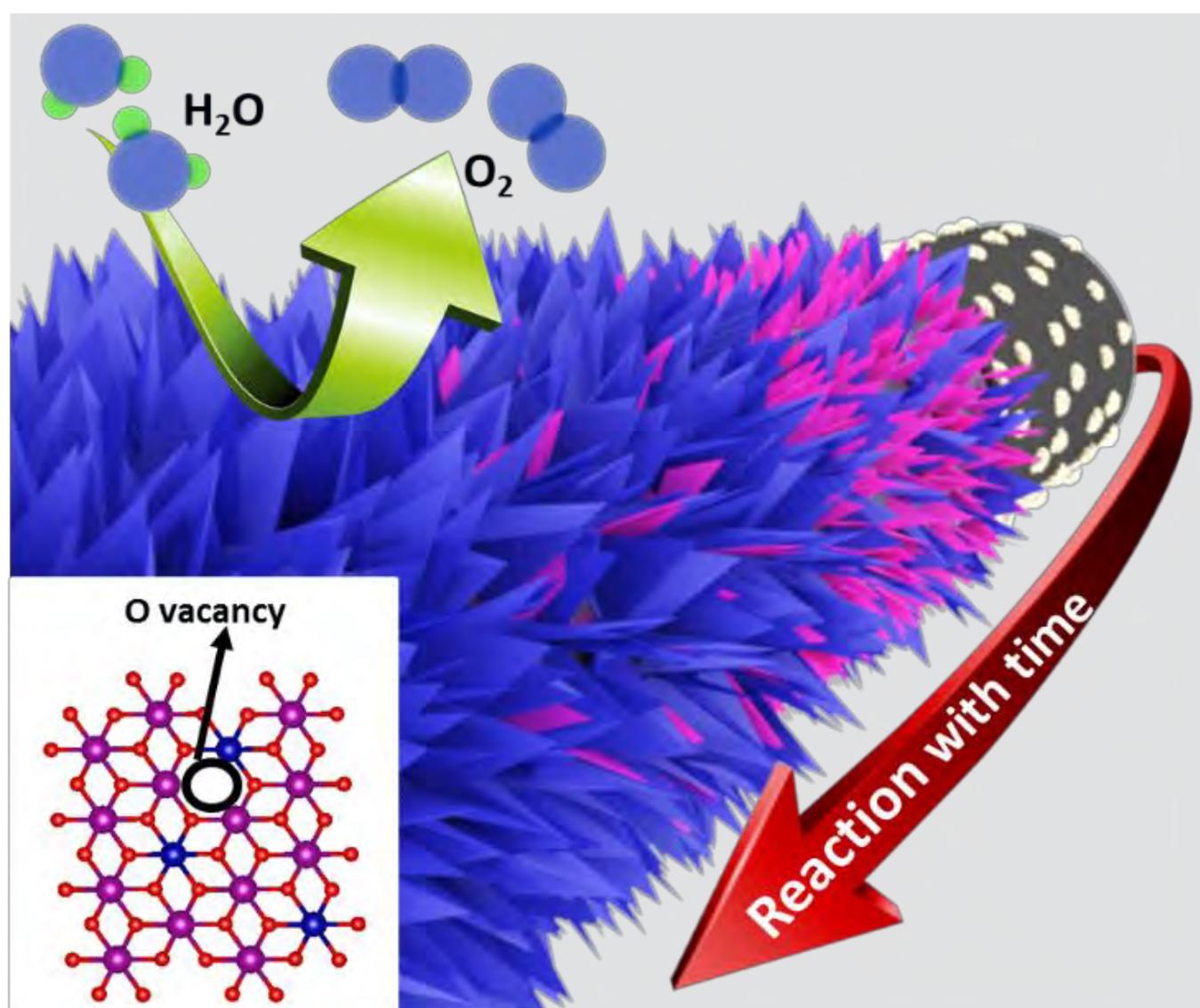
Abstract: Although lithium-sulfur batteries show great promise for next-generation energy storage due to their high energy density, the practical implementation of lithium-sulfur batteries has been largely impeded by the shuttle effect of lithium polysulfides and low areal capacity ($< 2 \text{ mAh cm}^{-2}$). Here we rationally design a new self-standing host enabled by a 3D hierarchically-porous titanium monoxide-graphene composite film to overcome the two issues at once. The hierarchically porous graphene scaffold not only can facilitate rapid lithium ion and electron transport, but also provide sufficient spaces to accommodate sulfur and buffer the volume expansion during the lithiation process. In addition, the ultrafine and polar titanium monoxide nanoparticles embedded in the three-dimensional graphene networks show strong chemical anchoring for polysulfides as evidenced by ex-situ X-ray photoelectron spectroscopy analysis, and their inherent metallic conductivity accelerates the redox reaction kinetics. Benefiting from this attractive architecture, the freestanding titanium monoxide-graphene/sulfur cathode delivered a high initial capacity of 1350 mAh g^{-1} at 0.1 C, a Coulombic efficiency approaching 100%, and a high-rate capacity of 832 mAh g^{-1} at 2 C. Moreover, when the areal sulfur loading was increased to 5.2 mg cm^{-2} , the titanium monoxide-graphene/sulfur electrode delivered a high areal capacity of 3.2 mAh cm^{-2} after 300 cycles at 0.2 C, demonstrating excellent cycling performance compared with other recently reported sulfur cathodes with high areal sulfur loadings.



<https://www.sciencedirect.com/science/article/pii/S221128551830137X>

18. Yufei Zhao, Jinqiang Zhang, Wenjian Wu, Xin Guo, Pan Xiong, Hao Liu, **Guoxiu Wang**, “Cobalt-Doped MnO₂ Ultrathin Nanosheets with Abundant Oxygen Vacancies Supported on Functionalized Carbon Nanofibers for Efficient Oxygen Evolution”, **Nano Energy** 54 (2018) 129-137. **IF= 13.120**

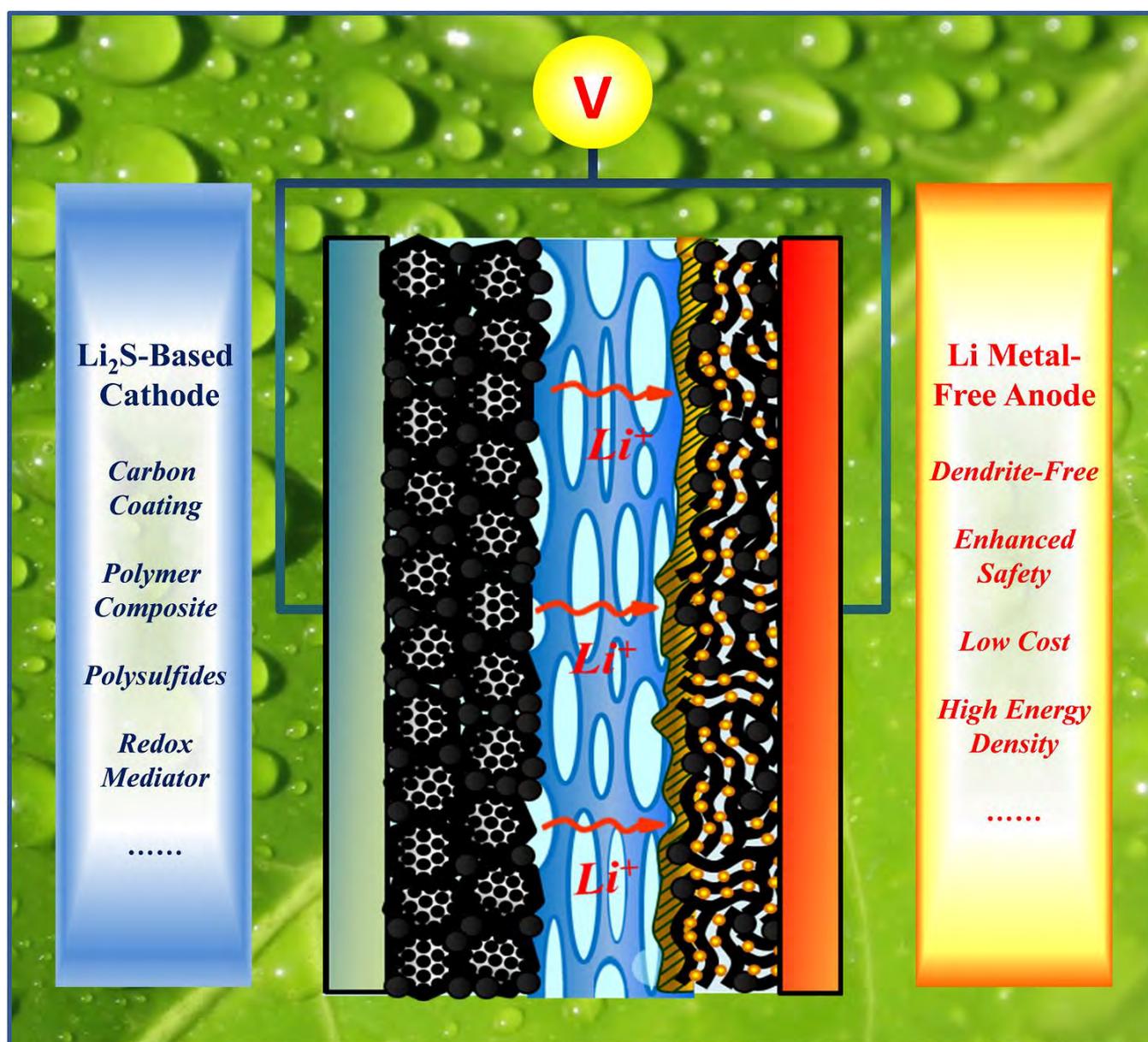
Abstract: Developing low-cost and efficient catalysts for oxygen evolution reactions (OER) with both excellent activity and robust stability remains a great challenge. Herein, we report a facile spontaneous redox reaction to grow cobalt-doped MnO₂ ultrathin nanosheets in situ with abundant oxygen vacancies vertically aligned on cobalt/nitrogen co-functionalized carbon nanofibers (Co-MnO₂|OV) as an efficient OER catalyst. It is confirmed that metallic cobalt plays a critical role in the formation of long and ultrathin MnO₂ nanosheets during the redox reaction. Furthermore, the cobalt ions doped into MnO₂ significantly enhance the catalytic activity of MnO₂ nanosheets. Benefiting from the collaborative advantages of doping strategy, fast charge transfer kinetics and strong synergistic coupling effects, Co-MnO₂|OV composites exhibit an excellent catalytic activity and a good durability for electrochemical water oxidation, reaching 10 mA cm⁻² at an overpotential of 279 mV. According to the density functional theory (DFT) calculations, the enhanced catalytic activity mainly originates from a better conductivity and the decreased adsorption energy barrier of OH⁻ on the O sites neighboring the doped Co and oxygen vacancies. Our findings suggest that the control over the structure and composition of the materials can achieve highly efficient oxygen evolution electrocatalysts.



<https://www.sciencedirect.com/science/article/pii/S2211285518307213>

19. Dawei Su, Dong Zhou, Chengyin Wang, **Guoxiu Wang**, “Toward High Performance Lithium-Sulfur Batteries Based on Li_2S Cathodes and Beyond: Status, Challenges, and Perspectives”, **Advanced Functional Materials** 28 (2018) 1800154. IF= 13.325

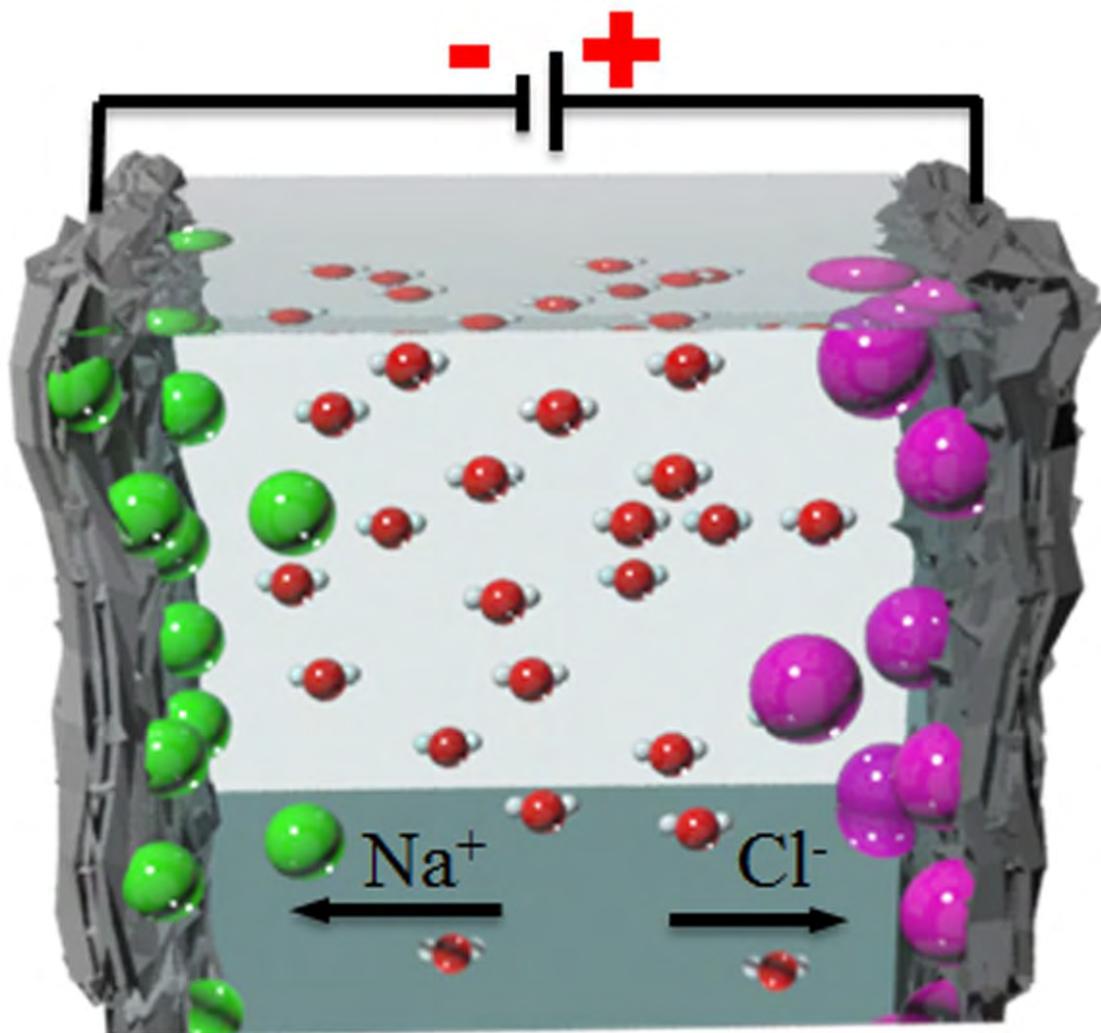
Abstract: Lithium sulfur (Li-S) batteries are attracting ever-increasing interests as a new generation rechargeable battery system with high energy density and low cost. Li-S batteries will fulfill their theoretical potential if the problem of polysulfides shuttle effect can be solved. Therefore, tremendous efforts have been devoted to overcoming this problem from the aspects of physical confinement and chemisorption of polysulfides. Recently, it is discovered that replacing sulfur cathodes with lithium sulfide (Li_2S) can not only largely avoid the volume expansion issue during cycling, but it can also work with anode materials other than lithium metal to eliminate serious safety concerns for traditional Li-S batteries. However, there are many challenges for developing practical Li metal-free Li-S battery systems, because Li_2S -based cathode materials are moisture-sensitive and prelithiation of the non-Li metal anode materials is usually required for practical applications. This study reviews the recent advances of Li-S batteries based on Li_2S cathode with features of improved safety, high Coulombic efficiency, and high energy density. The electrode activation processes are also discussed, which is critical for achieving high performances. It is anticipated that the extensive efforts will lead to breakthroughs for the development of Li_2S cathode -based Li-S batteries.



<https://onlinelibrary.wiley.com/doi/abs/10.1002/adfm.201800154>

20. Weizhai Bao, Xiao Tang, Xin Guo, Sinho Choi, Chengyin Wang, Yury Gogotsi, **Guoxiu Wang**, “Porous Cryo-Dried MXene for Efficient Capacitive Deionization”, *Joule* 2 (2018) 778-787.

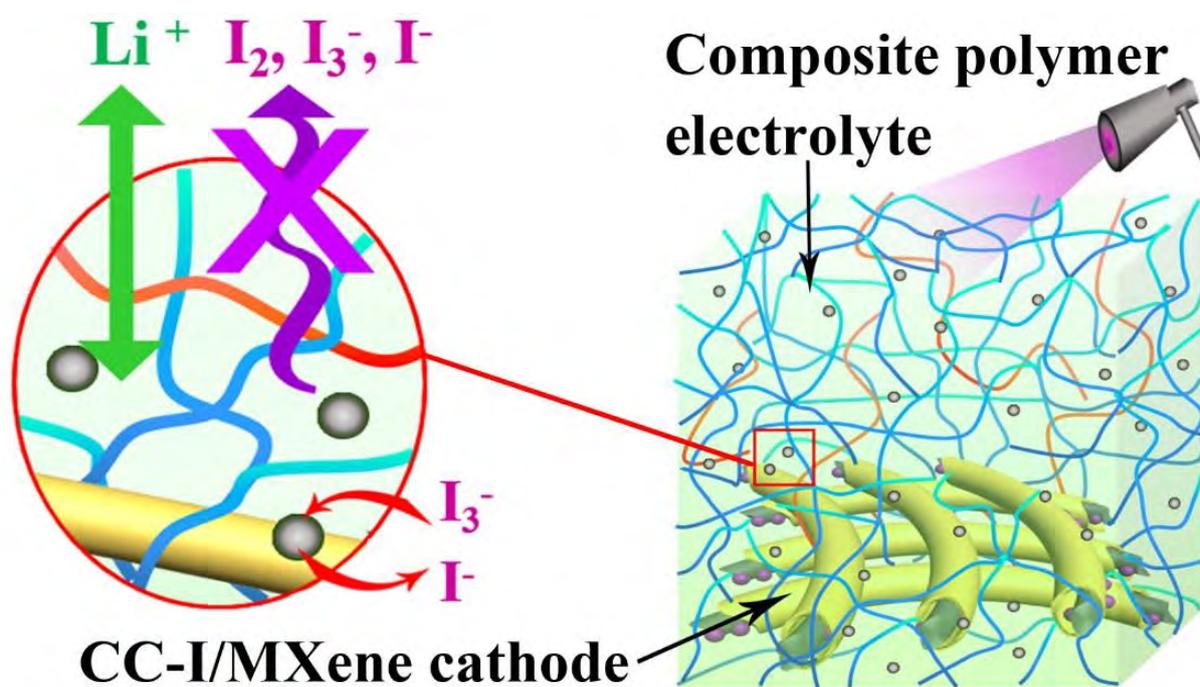
Abstract: We report a rationally designed process to produce an aerogel-like porous MXene electrode material for capacitive deionization. The intercalation-delamination of organic compounds and a vacuum freeze-drying technique were employed to prevent the restacking of MXene nanosheets due to van der Waals forces. The porous Ti_3C_2Tx is hydrophilic and has a well-defined porous structure with a high surface area and high electrical conductivity. When applied as electrodes in a capacitive deionization cell, porous Ti_3C_2Tx MXene electrodes exhibited an impressively high ion adsorption capacity of 118 mg/cm^3 in a salt solution with the concentration of $10,000\text{ mg/L}$, which is more than 12 times higher than previously reported carbon-based electrode materials. The porous MXene materials may open a new avenue for high-performance capacitive desalination.



<https://www.sciencedirect.com/science/article/pii/S2542435118300874#abs0015>

21. Xiao Tang, Dong Zhou, Peng Li, Xin Guo, Chengyin Wang, Feiyu Kang, Baohua Li, and **Guoxiu Wang**, “High-Performance Quasi-Solid-State MXene-Based Li-I Batteries”, **ACS Central Science**, Article ASAP.(DOI: 10.1021/acscentsci.8b00921). **IF=11.228**.

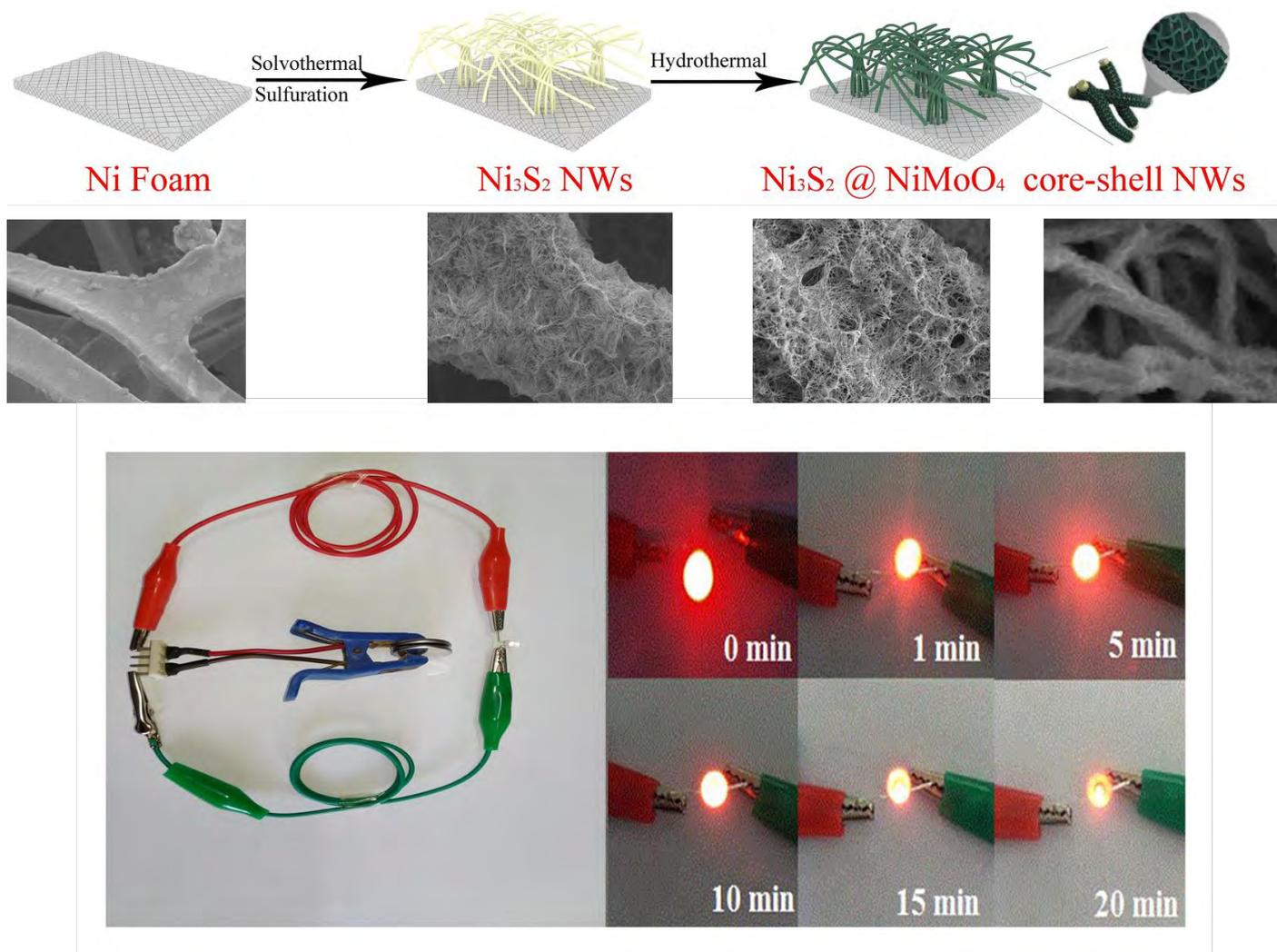
Abstract: Lithium-iodine (Li-I) batteries have attracted tremendous attention due to their high energy and power densities as well as the low cost of iodine. However, the severe shuttle effect of iodine species and the uncontrollable lithium dendrite growth have strongly hindered their practical applications. Here we successfully develop a quasi-solid-state Li-I battery enabled by a MXene-based iodine cathode and a composite polymer electrolyte (CPE) containing NaNO_3 particles dispersing in a pentaerythritol-tetraacrylate-based (PETEA-based) gel polymer electrolyte. As verified by experimental characterizations and first-principle calculations, the abundant functional groups on the surface of MXene sheets provide strong chemical binding to iodine species, and therefore immobilize their shuttling. The PETEA-based polymer matrix simultaneously suppresses the diffusion of iodine species and stabilizes the Li anode/CPE interface against dendrite growth. The NaNO_3 particles act as an effective catalyst to facilitate the transformation kinetics of LiI_3 on the cathode. Owing to such synergistic optimization, the as-developed Li-I batteries deliver high energy/power density with long cycling stability and good flexibility. This work opens up a new avenue to improve the performance of Li-I batteries.



<https://pubs.acs.org/doi/full/10.1021/acscentsci.8b00921>

22. Fangshuai Chen, Shan Ji, Quanbing Liu, Hui Wang, Hao Liu, Dan J. L. Brett, **Guoxiu Wang**, Rongfang Wang, “Rational Design of Hierarchically Core-Shell Structured Ni₃S₂@NiMoO₄ Nanowires for Electrochemical Energy Storage”, *Small* 14 (2018) 1800791. **IF= 9.598**

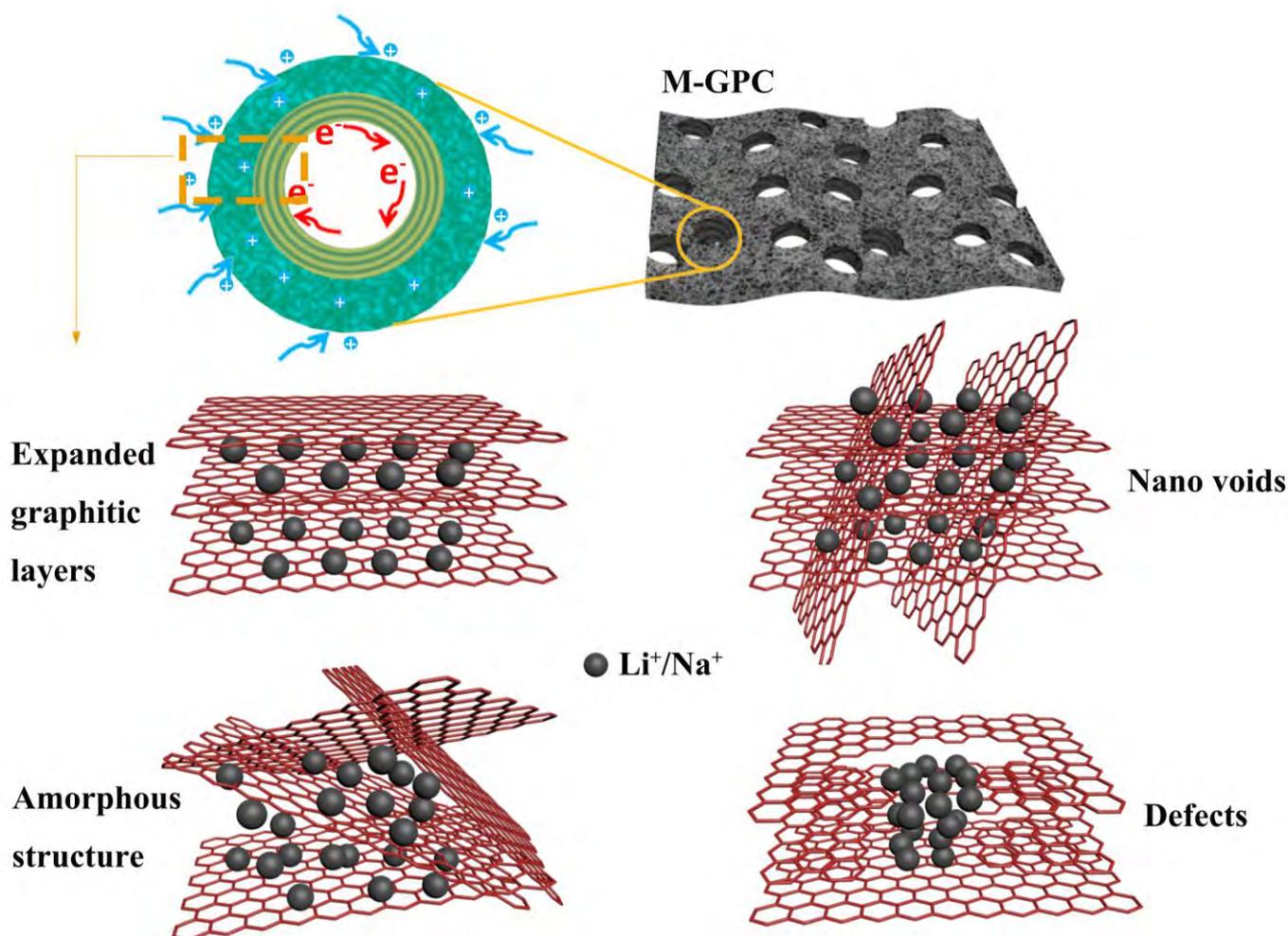
Abstract: Rational design and controllable synthesis of nanostructured materials with unique microstructure and excellent electrochemical performance for energy storage are crucially desired. In this paper, a facile method is reported for general synthesis of hierarchically core-shell structured Ni₃S₂@NiMoO₄ nanowires (NWs) as a binder-free electrode for asymmetric supercapacitors. Due to the intimate contact between Ni₃S₂ and NiMoO₄, the hierarchical structured electrodes provide a promising unique structure for asymmetric supercapacitors. The as-prepared binder-free Ni₃S₂@NiMoO₄ electrode can significantly improve the electrical conductivity between Ni₃S₂ and NiMoO₄, and effectively avoid the aggregation of NiMoO₄ nanosheets, which provide more active space for storing charge. The Ni₃S₂@NiMoO₄ electrode presents a high areal capacity of 1327.3 $\mu\text{Ah cm}^{-2}$ and 67.8% retention of its initial capacity when current density increases from 2 to 40 mA cm^{-2} . In a two-electrode Ni₃S₂@NiMoO₄//active carbon cell, the active materials deliver a high energy density of 121.5 Wh kg^{-1} at a power density of 2.285 kW kg^{-1} with excellent cycling stability.



<https://onlinelibrary.wiley.com/doi/abs/10.1002/sml.201800791>

23. Wang Yang, Wu Yang, Fan Zhang, **Guoxiu Wang**, Guangjie Shao, “Hierarchical Interconnected Expanded Graphitic Ribbons Embedded with Amorphous Carbon: An Advanced Carbon Nanostructure for Superior Lithium and Sodium Storage”, *Small* 14 (2018) 1802221. **IF= 9.598**

Abstract: Carbon materials have attracted considerable attention as anodes for lithium-ion and sodium-ion batteries due to their low cost and environmental friendliness. This work reports an advanced carbon nanostructure that takes advantage of the chelation effect of glucose and metal ions, which ensures the uniform dispersion of metal in the precursor. Thus, an effective catalytic conversion from sp^3 to sp^2 carbon occurs, enabling simultaneously formation of pores with catalyzed graphitic structures. Due to the low carbonization temperature and short carbonization time as well as the different catalytic degree of various metals, a series of expanded graphitic layers from 0.34 to 0.44 nm with defects and amorphous carbon structure are obtained. The structure not only offers accessible graphitic spacings for reversible lithium/sodium ion insertion, but also provides abundant active sites for lithium/sodium ion adsorption in the defects and amorphous structure. Moreover, the hierarchical interconnected porous structure combining graphitic ribbons is beneficial for fast electronic/ionic transport and favorable electrolyte permeation. More importantly, such advanced carbon materials prove their feasibility for balancing the pore structure and degree of graphitization. When serving as the electrode material for lithium-ion and sodium-ion batteries, excellent electrochemical performance along with fast kinetics and long cycle life is achieved.



<https://onlinelibrary.wiley.com/doi/abs/10.1002/sml.201802221>