Electronic Supplementary Material (ESI) for Energy & Environmental Science.


# $SnO_2$ Nanoparticles Anchored on Carbon Foam as Freestanding Anode for High Performance Potassium-Ion Batteries

*Hailong Qiu, Lina Zhao, Xiaoxiao Huang, Muhammad Asif, Tianyu Tang, Wei Li, Teng Zhang, Tong Shen, Yanglong Hou**

Beijing Key Laboratory for Magnetoelectric Materials and Devices (BKLMMD), Beijing Innovation Center for Engineering Science and Advanced Technology (BIC-ESAT),
Department of Materials Science and Engineering, College of Engineering, Peking University, Beijing 100871, China

**Corresponding Author**

* Email: hou@pku.edu.cn

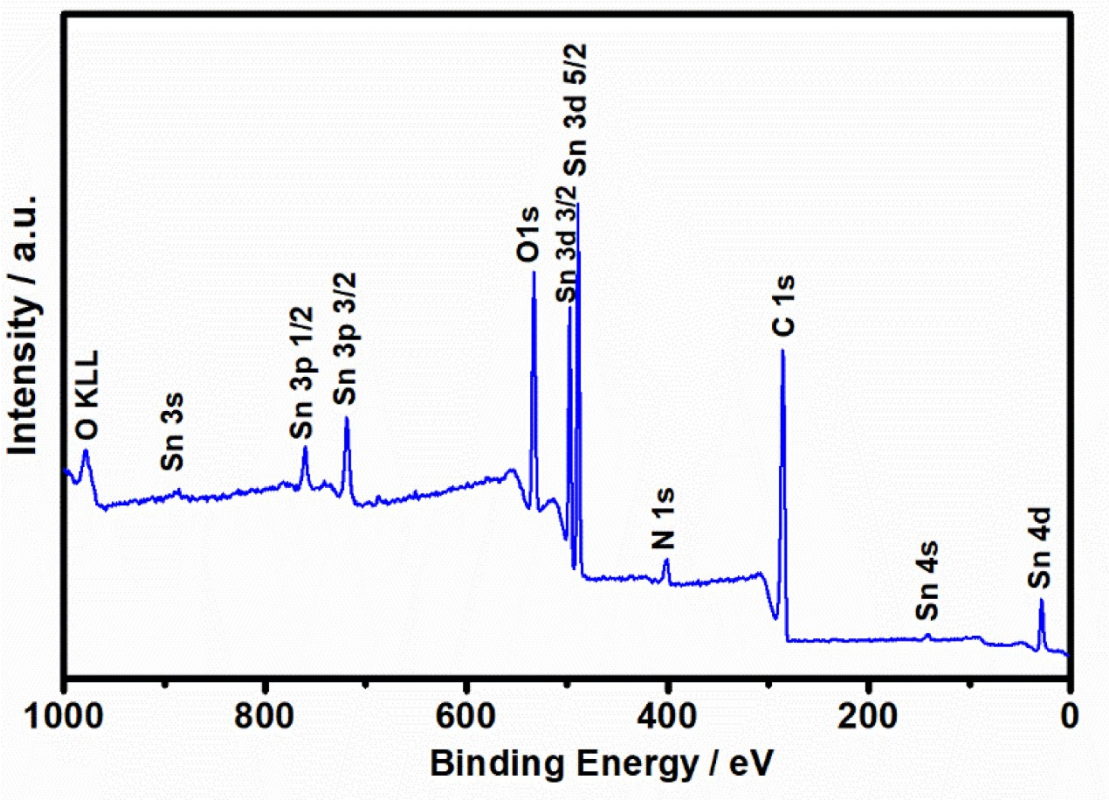


**Figure S1. XPS survey spectra of $SnO_2$@CF.**

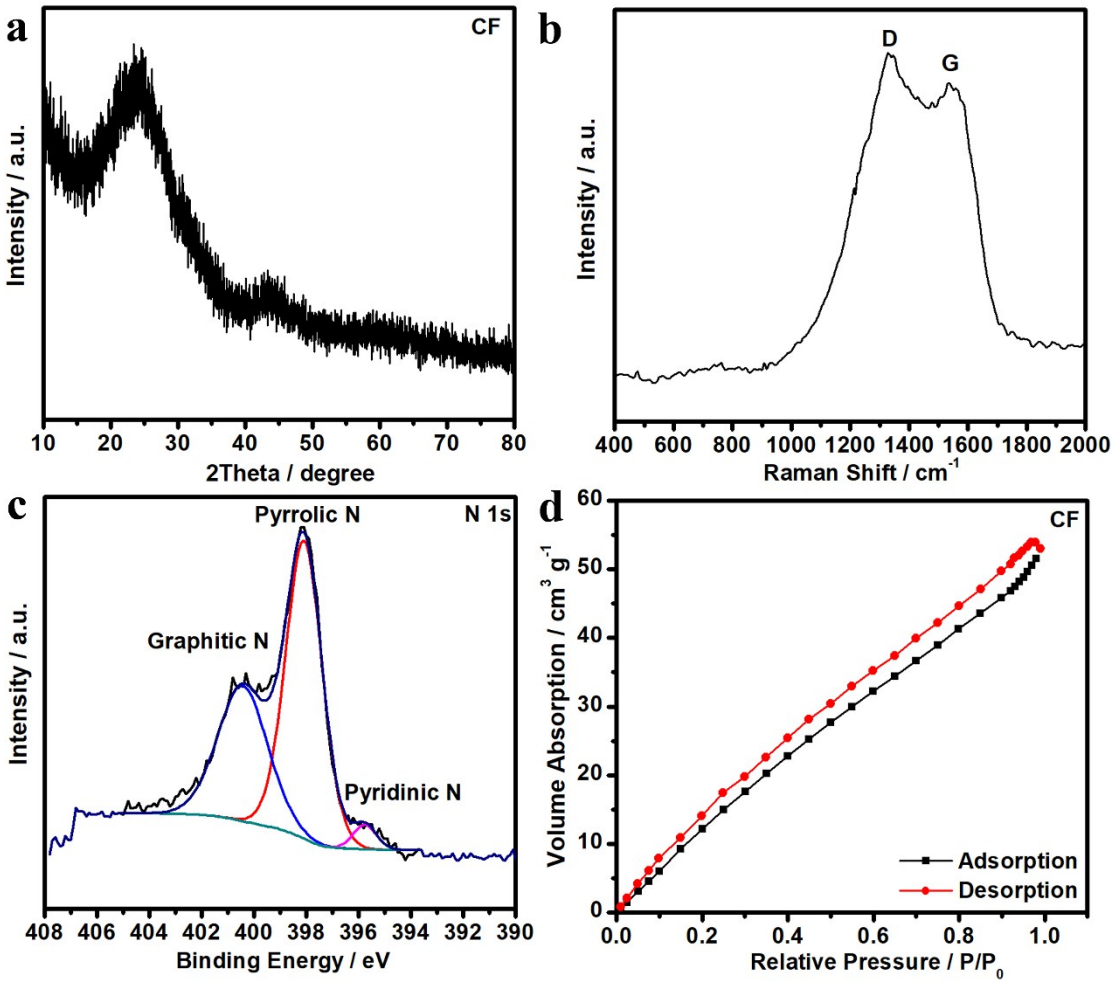


**Figure S2. (a) XRD patterns and (b) Raman spectra of $SnO_2$@CF. The high-resolution (c) N 1s XPS spectra and (d) $N_2$ adsorption and desorption isotherms of CF.**

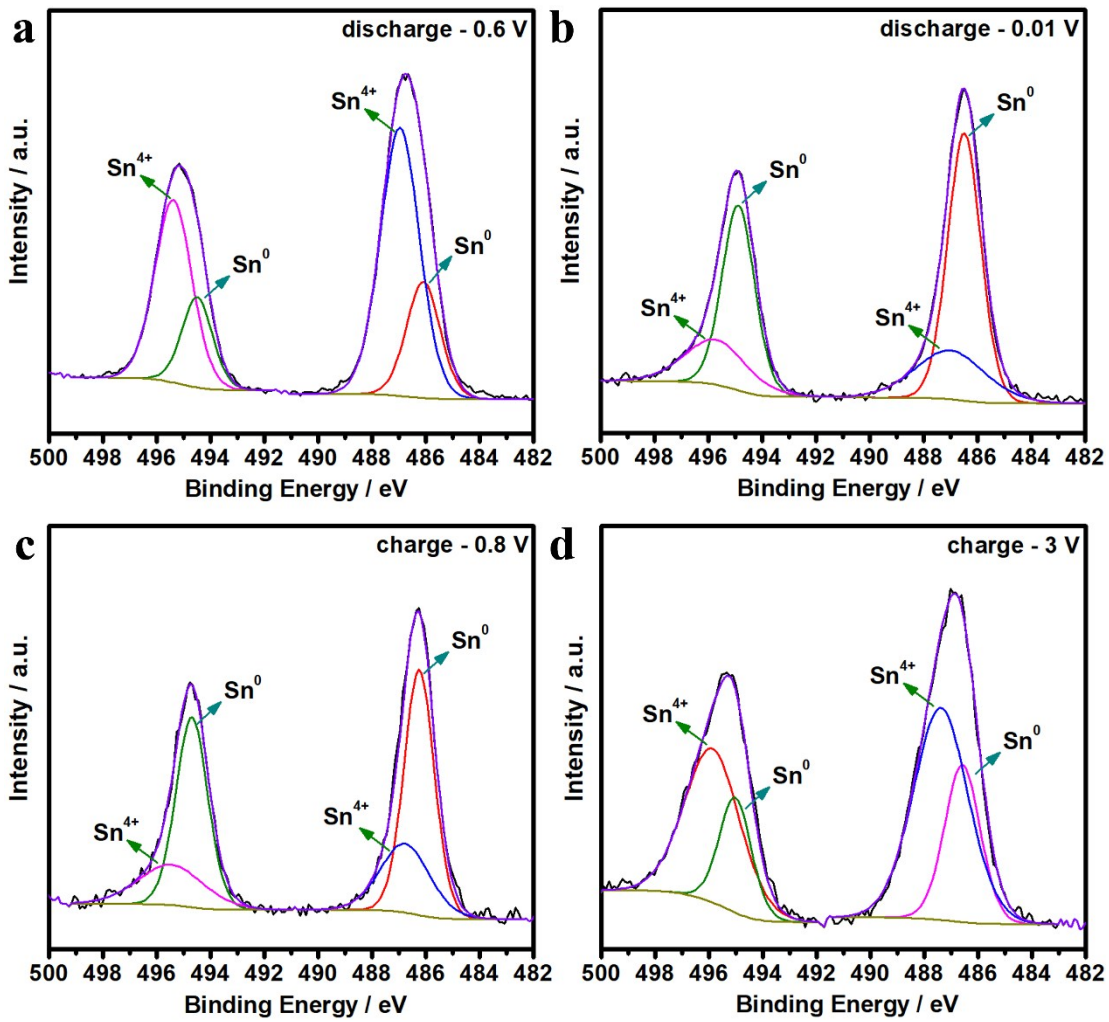


**Figure S3. Ex-situ XPS of $SnO_2$@CF for K storage at different charge/discharge states in the first cycle, Sn 3d: (a) discharge to 0.6 V, (b) discharge to 0.01 V, (c) charge to 0.8 V and (d) charge to 3 V.**

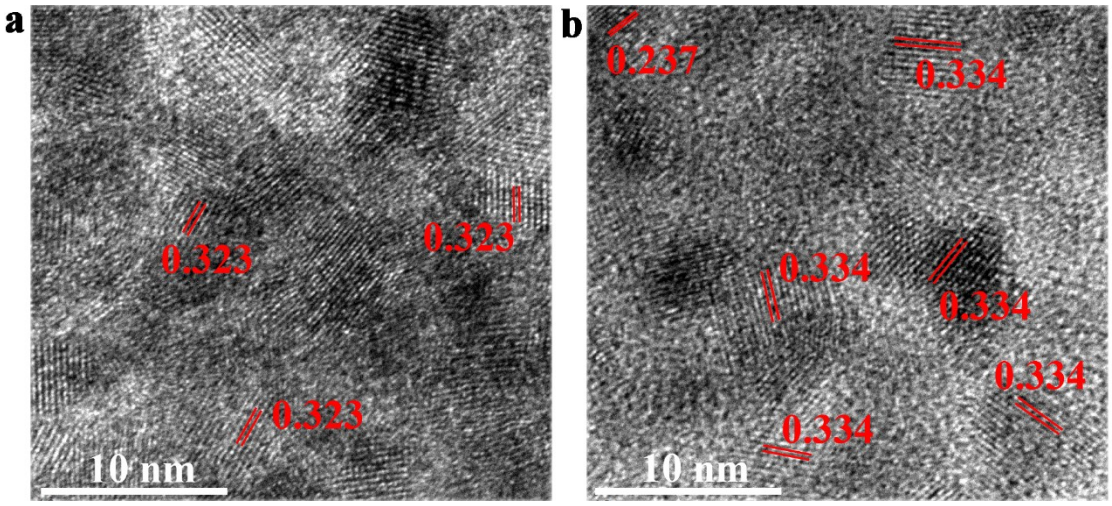


**Figure S4. HRTEM images of $SnO_2$@CF electrode materials observed (a) at fully discharged and (b) at fully charged states.**

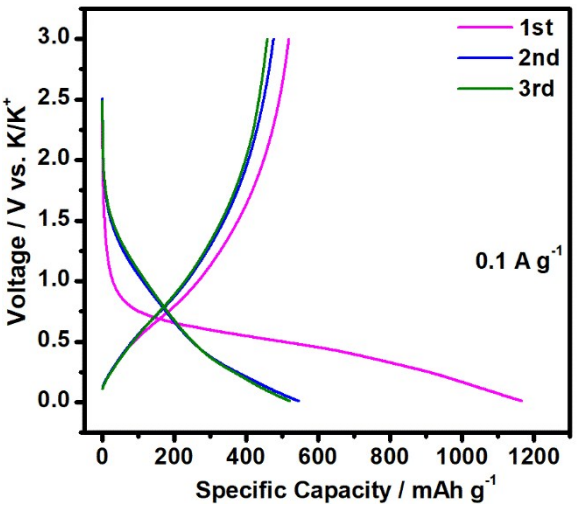


**Figure S5. Galvanostatic charge and discharge curves at 0.1 A $g^{-1}$ for the initial three cycles.**

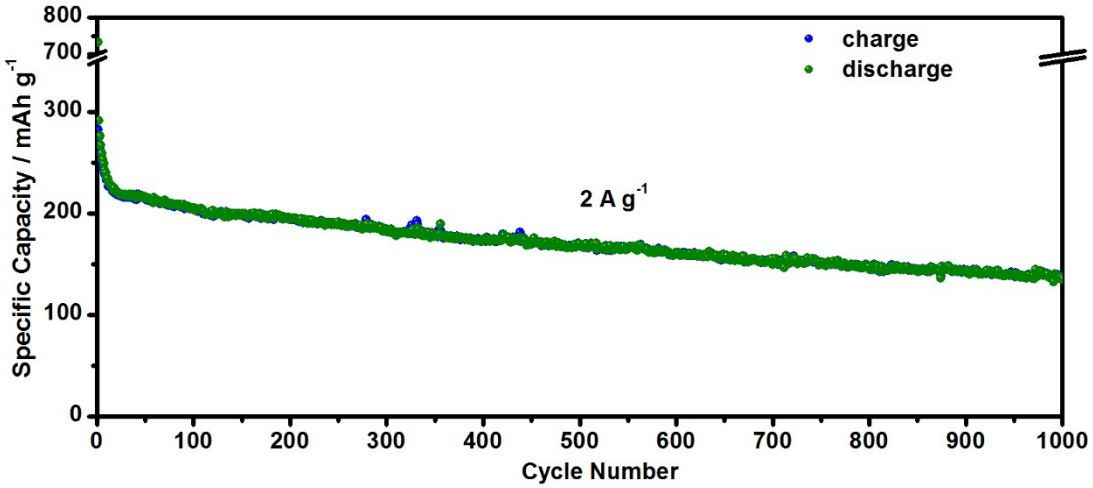


**Figure S6. Cycle stability of $SnO_2$@CF for K ions storage at 2 A $g^{-1}$.**

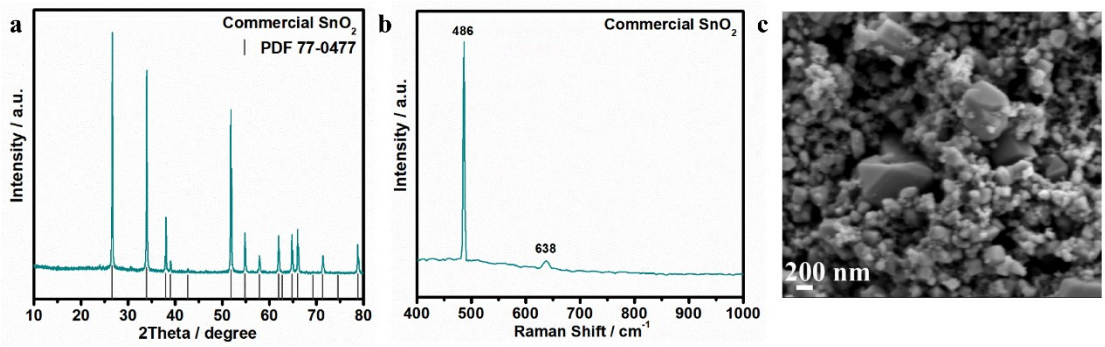


**Figure S7. (a) XRD patterns, (b) Raman spectra and (c) SEM image of commercial $SnO_2$.**

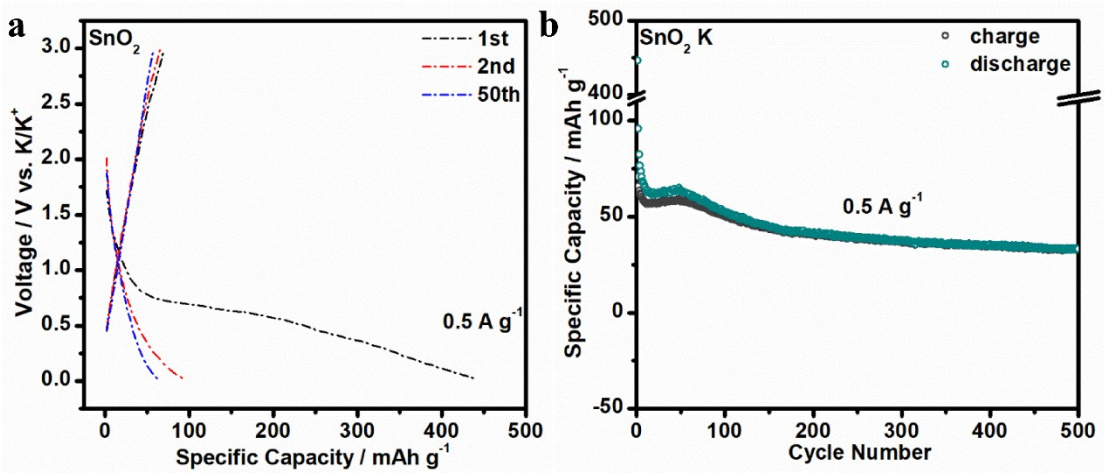


**Figure S8. Electrochemical performances of $SnO_2$, (a) Galvanostatic charge and discharge curves and (b) cycle stability at 0.5 A $g^{-1}$ for K ions storage.**

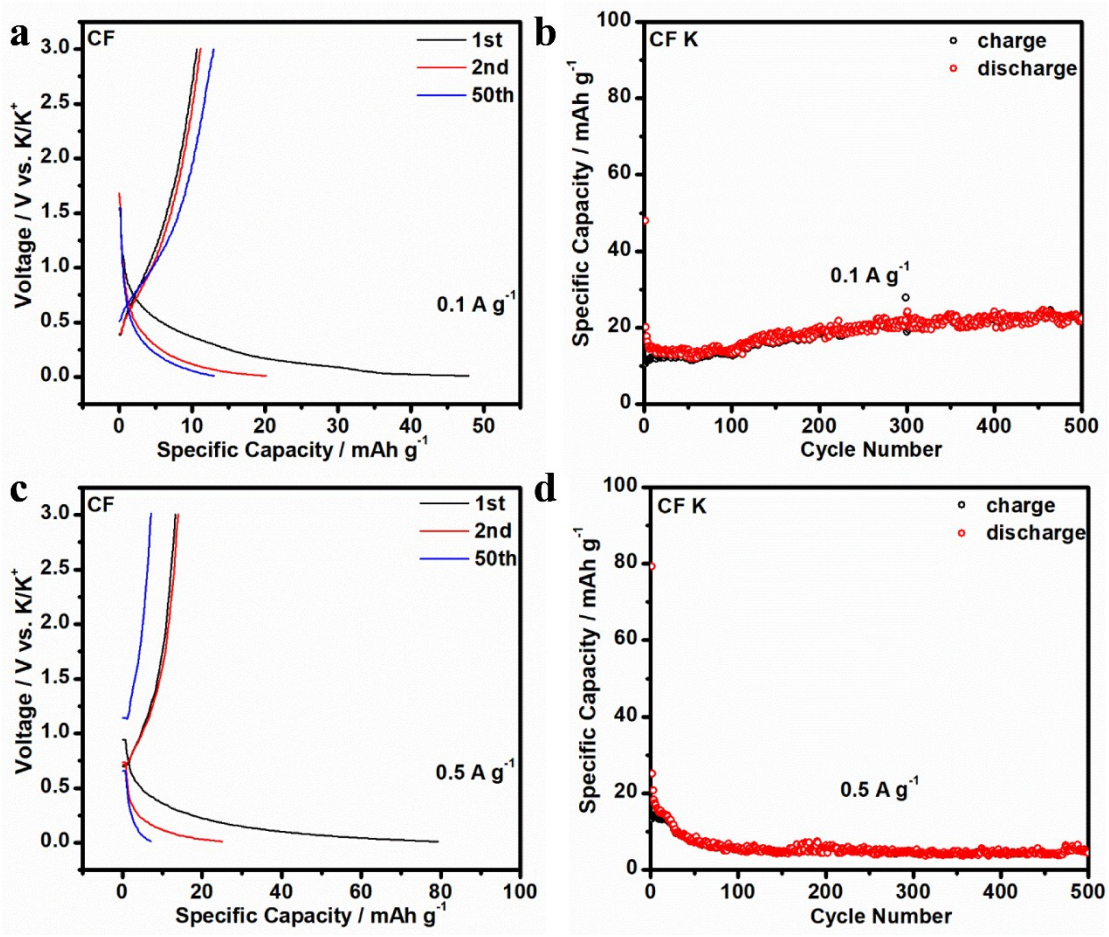


**Figure S9. Electrochemical performances of CF for K ions storage, (a) Galvanostatic charge and discharge curves and (b) cycle stability at 0.1 A $g^{-1}$. (c) Galvanostatic charge and discharge curves and (d) Cycle stability at 0.5 A $g^{-1}$.**

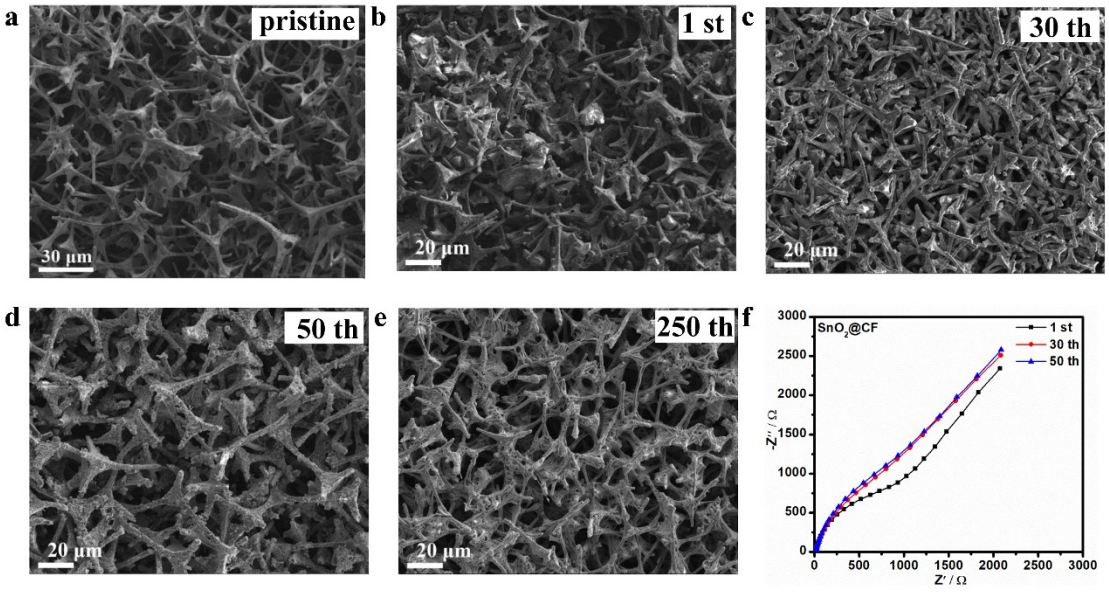


**Figure S10. (a-e) SEM images of $SnO_2$@CF after different cycles for K ions storage. (f) Nyquist plots of $SnO_2$@CF after different cycles.**

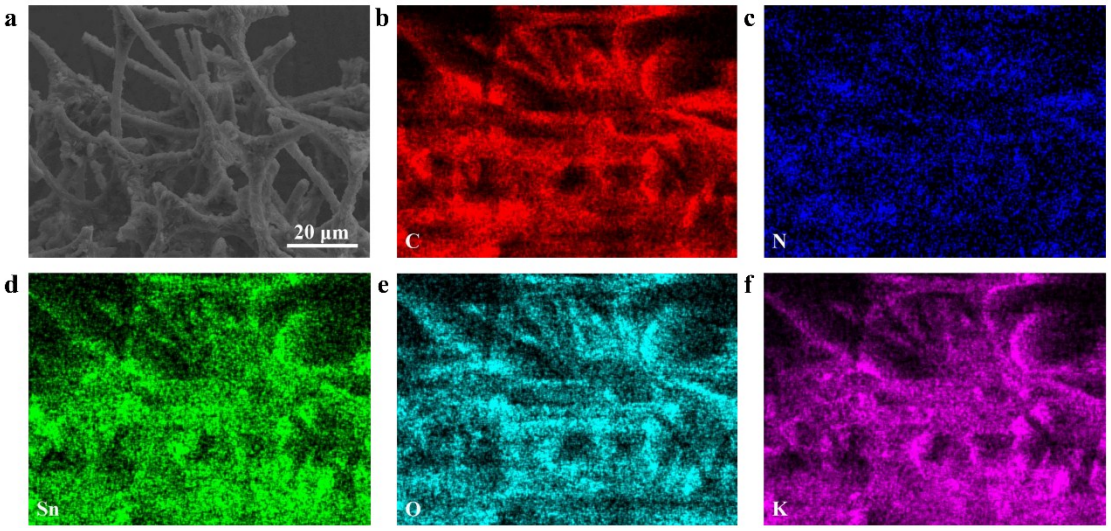


**Figure S11. (a) SEM image of the $SnO_2$@CF electrode after cycling. (b) C, (c) N, (d) Sn, (e) O and (f) k elemental mapping of the $SnO_2$@CF electrode after cycling.**

**Table S1. Comparison of electrochemical performance of the $SnO_2$@CF anode with the previously reported $SnO_2$ based PIBs anodes.**

| Material | Capacity-Current density | Cycle performance | Energy density | Reference |
|---|---|---|---|---|
| $SnO_2$@CF | 564.2 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>440.0 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>371.4 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>307.6 mAh $g^{-1}$ at 1 A $g^{-1}$<br>247.3 mAh $g^{-1}$ at 2 A $g^{-1}$<br>143.5 mAh $g^{-1}$ at 5 A $g^{-1}$ | 398.8 mAh $g^{-1}$ at 0.1 A $g^{-1}$ after 150 cycles<br>231.7 mAh $g^{-1}$ at 1 A $g^{-1}$ after 400 cycles<br>136.1 mAh $g^{-1}$ at 2 A $g^{-1}$ after 1000 cycles | 227.1 Wh $kg^{-1}$ (0.1 A $g^{-1}$) | this work |
| P-SGC | 287.0 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>237.3 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>208.5 mAh $g^{-1}$ at 1 A $g^{-1}$ | 285.9 mAh $g^{-1}$ at 0.1 A $g^{-1}$ after 60 cycles | ~253.2 Wh $kg^{-1}$ (0.1 A $g^{-1}$) | [1] |
| $SnO_2$@G@C | 270.1 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>219.9 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>159.2 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>114.8 mAh $g^{-1}$ at 1 A $g^{-1}$ | 202.06 mAh $g^{-1}$ at 0.1 A $g^{-1}$ after 100 cycles | ~135.6 Wh $kg^{-1}$ (0.1 A $g^{-1}$) | [2] |
| SnO | 229 mAh $g^{-1}$ at 5 mA $g^{-1}$ | 183 mAh $g^{-1}$ at 25 mA $g^{-1}$ after 30 cycles | ~75.3 Wh $kg^{-1}$ 25 $mAg^{-1}$ | [3] |
| G@C@S | 179 mAh $g^{-1}$ at 0.1 A $g^{-1}$ | 147.8 mAh $g^{-1}$ at | ~153.7 | [4] |

| | | | | |
|---|---|---|---|---|
| $nO_2$ | 150 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>129 mAh $g^{-1}$ at 0.3 A $g^{-1}$<br>119 mAh $g^{-1}$ at 0.4 A $g^{-1}$ | 0.05 A $g^{-1}$ after 85 cycles | Wh $kg^{-1}$ (0.1 A $g^{-1}$) | |
| $SnO_2$@SSM | 472 mAh $g^{-1}$ at 0.05 A $g^{-1}$<br>361 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>292 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>195 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>125 mAh $g^{-1}$ at 1 A $g^{-1}$ | 351 mAh $g^{-1}$ at 0.05 A $g^{-1}$ after 100 cycles<br>128 mAh $g^{-1}$at 15 A $g^{-1}$ after 200 cycles | ~188.2 Wh $kg^{-1}$ (0.1 A $g^{-1}$) | [5] |

**Notes:**

**The energy density is calculated based solely on the mass of the active materials.**

**P-SGC:** phosphoric acid doped $SnO_2$-graphene-carbon nanofibers

**$SnO_2$@G@C:** $SnO_2$-graphene-carbon nanofiber

**G@C@$SnO_2$:** Dual Carbon-Confined $SnO_2$ Hollow Nanospheres

**$SnO_2$@SSM:** $SnO_2$ nanosheets grown on stainless steel mesh

**Table S2. Comparison of electrochemical performance of the $SnO_2$@CF anode with the other state-of-the-art PIBs anodes.**

| Material | Capacity-Current density | Cycle performance | Reference |
|---|---|---|---|
| $SnO_2$@CF | 564.2 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>440.0 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>371.4 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>307.6 mAh $g^{-1}$ at 1 A $g^{-1}$<br>247.3 mAh $g^{-1}$ at 2 A $g^{-1}$<br>143.5 mAh $g^{-1}$ at 5 A $g^{-1}$ | 398.8 mAh $g^{-1}$ at 0.1 A $g^{-1}$ after 150 cycles<br>231.7 mAh $g^{-1}$ at 1 A $g^{-1}$ after 400 cycles<br>136.1 mAh $g^{-1}$ at 2 A $g^{-1}$ after 1000 cycles | this work |
| $SnP_{0.94}$@GO | 309 mAh $g^{-1}$ at 0.025 A $g^{-1}$<br>84 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>57 mAh $g^{-1}$ at 1 A $g^{-1}$ | 162 mAh $g^{-1}$ at 0.1 A $g^{-1}$ after 50 cycles | 6 |
| $SnS_2$@C@rGO | 721.9 mAh $g^{-1}$ at 0.05 A $g^{-1}$<br>397.4 mAh $g^{-1}$ at 2 A $g^{-1}$ | 298.1 mAh $g^{-1}$ at 0.5 A $g^{-1}$ after 500 cycles | 7 |
| ZnSC@C@RGO | 419 mAh $g^{-1}$ at 0.02 A $g^{-1}$<br>362 mAh $g^{-1}$ at 0.05 A $g^{-1}$<br>295 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>223 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>162 mAh $g^{-1}$ at 0.5 A $g^{-1}$ | 254 mAh $g^{-1}$ at 0.1 A $g^{-1}$ after 100 cycles<br>208 mAh $g^{-1}$ at 0.5 A $g^{-1}$ after 300 cycles | 8 |

| | | | |
|---|---|---|---|
| $FeS_2$@G@C NF | 406 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>332 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>243 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>171 mAh $g^{-1}$ at 1 A $g^{-1}$ | 120 mAh $g^{-1}$ at 1 A $g^{-1}$ after 680 cycles | 9 |
| CoS@C | 486.7 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>381.9 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>306.7 mAh $g^{-1}$ at 0.4 A $g^{-1}$<br>244.8 mAh $g^{-1}$ at 0.8 A $g^{-1}$<br>201.6 mAh $g^{-1}$ at 1.6 A $g^{-1}$ | 401.2 mAh $g^{-1}$ at 0.1 A $g^{-1}$ after 100 cycles | 10 |
| $MoS_2$@NC | 258 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>238 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>204 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>171 mAh $g^{-1}$ at 1 A $g^{-1}$ | 212 mAh $g^{-1}$ at 0.1 A $g^{-1}$ after 100 cycles | 11 |
| $TiNb_2O_6$@M $oS_{2@}$C | 420 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>373 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>309 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>233 mAh $g^{-1}$ at 1 A $g^{-1}$ | 174 mAh $g^{-1}$ at 1 A $g^{-1}$ after 300 cycles | 12 |
| $MoSe_2$@MXe ne@C | 350 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>324 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>294 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>270 mAh $g^{-1}$ at 1 A $g^{-1}$ | 355 mAh $g^{-1}$ at 0.2 A $g^{-1}$ after 100 cycles<br>317 mAh $g^{-1}$ at 1 A $g^{-1}$ after 300 cycles | 13 |
| $VSe_2$ | 374 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>350 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>334 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>269 mAh $g^{-1}$ at 1 A $g^{-1}$ | 335 mAh $g^{-1}$ at 0.2 A $g^{-1}$ after 200 cycles | 14 |
| $ReSe_2$@G@ CNFs | 254 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>157 mAh $g^{-1}$ at 2 A $g^{-1}$ | 230 mAh $g^{-1}$ at 0.2 A $g^{-1}$ after 200 cycles | 15 |
| VN@QDS@ | 261mAh $g^{-1}$ at 0.1 A $g^{-1}$ | 228 mAh $g^{-1}$ at 0.1 A $g^{-1}$ | 16 |

| | | | |
|---|---|---|---|
| CM | 215 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>187 mAh $g^{-1}$ at 1 A $g^{-1}$<br>152 mAh $g^{-1}$ at 2 A $g^{-1}$ | after 100 cycles<br>215 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>after500 cycles | |
| $V_2O_3$@PNCNFs | 240 mAh $g^{-1}$ at 0.05 A $g^{-1}$<br>134 mAh $g^{-1}$ at 1 A $g^{-1}$ | ~215 mAh $g^{-1}$ at 0.05 A $g^{-1}$ after 500 cycles | 17 |
| $TiO_2$@C | 208.5 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>180.1 mAh $g^{-1}$ at 0.4 A $g^{-1}$<br>114.6 mAh $g^{-1}$ at 1 A $g^{-1}$<br>97.3 mAh $g^{-1}$ at 2 A $g^{-1}$ | 132.8 mAh $g^{-1}$ at 0.5 A $g^{-1}$ after 1200 cycles | 18 |
| $MoO_2$@rGO | 281.8 mAh $g^{-1}$ at 0.05 A $g^{-1}$<br>240.3 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>214.1 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>176.4 mAh $g^{-1}$ at 0.5 A $g^{-1}$ | 218.9 mAh $g^{-1}$ at 0.05 A $g^{-1}$ after 200 cycles<br>104.2 mAh $g^{-1}$ at 0.5 A $g^{-1}$ after 500 cycles | 19 |
| $Nb_2O_{5-x}$@rGO | 111 mAh $g^{-1}$ at 1 A $g^{-1}$<br>73 mAh $g^{-1}$ at 3 A $g^{-1}$ | 81 mAh $g^{-1}$ at 1.5 A $g^{-1}$<br>after 3500 cycles | 20 |
| FeP@CNBs | 201 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>156 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>101 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>65 mAh $g^{-1}$ at 1 A $g^{-1}$ | 205 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>after 300 cycles | 21 |
| P@N-PHCNFs | 745 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>689 mAh $g^{-1}$ at 0.3 A $g^{-1}$<br>651 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>613 mAh $g^{-1}$ at 1 A $g^{-1}$ | 465 mAh $g^{-1}$ at 2 A $g^{-1}$<br>after 800 cycles | 22 |
| Bi | 398.4 mAh $g^{-1}$ at 0.02 A $g^{-1}$ | 322.7 mAh $g^{-1}$ at 0.8 A $g^{-1}$ after 300 cycles | 23 |

| | | | |
|---|---|---|---|
| MXene@Sb | 503.84 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>459.98 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>393.58 mAh $g^{-1}$ at 0.3 A $g^{-1}$<br>335.54 mAh $g^{-1}$ at 0.4 A $g^{-1}$<br>270.81 mAh $g^{-1}$ at 0.5 A $g^{-1}$ | 270 mAh $g^{-1}$ at 0.5 A $g^{-1}$ after 500 cycles | 24 |
| np-Ge | 290 mAh $g^{-1}$ at 0.02 A $g^{-1}$ | 120 mAh $g^{-1}$ at 0.02 A $g^{-1}$ after 400 cycles | 25 |
| NCNF | 238 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>217 mAh $g^{-1}$ at 0.3 A $g^{-1}$<br>192 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>172 mAh $g^{-1}$ at 1 A $g^{-1}$ | 205 mAh $g^{-1}$ at 0.5 A $g^{-1}$ after 1000 cycles<br>164 mAh $g^{-1}$ at 1 A $g^{-1}$ after 2000 cycles | 26 |
| NHC | 266.1 mAh $g^{-1}$ at 0.1 A $g^{-1}$<br>260.9 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>242.6 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>224.3 mAh $g^{-1}$ at 1 A $g^{-1}$ | 161.3 mAh $g^{-1}$ at 1 A $g^{-1}$ after 1600 cycles | 27 |
| SHCS | 202 mAh $g^{-1}$ at 1.5 A $g^{-1}$<br>160 mAh $g^{-1}$ at 3 A $g^{-1}$<br>110 mAh $g^{-1}$ at 5 A $g^{-1}$ | ~284 mAh $g^{-1}$ at 0.2 A $g^{-1}$ after 1000 cycles | 28 |
| SOPCMs | 230 mAh $g^{-1}$ at 0.05 A $g^{-1}$<br>213 mAh $g^{-1}$ at 0.2 A $g^{-1}$<br>176 mAh $g^{-1}$ at 0.5 A $g^{-1}$<br>158 mAh $g^{-1}$ at 1 A $g^{-1}$ | 226.6 mAh $g^{-1}$ at 0.05 A $g^{-1}$ after 100 cycles<br>108.4 mAh $g^{-1}$ at 1 A $g^{-1}$ after 2000 cycles | 29 |
| ADAPTS | 66 mAh $g^{-1}$ at 1.55 A $g^{-1}$ | 70 mAh $g^{-1}$ at 0.155 A $g^{-1}$ after 1000 cycles | 30 |

**Notes:**

**ZnSC@C@RGO:** carbon-encapsulated ZnS subunits nanosphere@carbon nanosphere@ reduced graphene oxide networks

**$FeS_2$@G@CNF**: $FeS_2$@graphene@carbon nanofibers

**CoS@C**: 3D amorphous carbon-encapsulated CoS@nitrogen-doped carbon nanofiber nanotube/CoS-coated carbon nanofiber (AC@CoS/NCNTs/CoS@CNFs) network

**$MoS_2$@NC**: $MoS_2$@N-doped-C

**$TiNb_2O_6$@$MoS_{2@}$C**: porous metallic $TiNb_2O_6$ as the core and carbon encapsulated $MoS_2$ nanosheets as the shell

**$ReSe_2$@G@CNFs**: $ReSe_2$–carbon nanofiber

**VN-QDS@CM**: VN quantum dots encapsulated in ultralarge pillared N-doped mesoporous carbon microsheets

**$V_2O_3$@PNCNFs**: $V_2O_3$ nanoparticles embedded in porous N-doped carbon nanofiber

**FeP@CNBs**: yolk–shell FeP@C nanoboxes

**P@N-PHCNFs**: P @free-standing nitrogen-doped porous hollow carbon nanofiber

**np-Ge**: Nanoporous Ge

**NCNF**: N-doped carbon nanofibers

**SHCS**: sulfur-grafted hollow carbon spheres

SOPCMs: sulfur and oxygen codoped porous hard carbon microspheres

**ADAPTS**: azobenzene-4,4′-dicarboxylic acid potassium salts

## References


1. Z. Huang, Z. Chen, S. Ding, C. Chen and M. Zhang, *Nanotechnology*, 2018, **29**, 375702.
2. Z. Huang, Z. Chen, S. Ding, C. Chen and M. Zhang, *Materials Letters*, 2018, **219**, 19-22.
3. M. Shimizu, R. Yatsuzuka, T. Koya, T. Yamakami and S. Arai, *ACS Applied Energy Materials*, 2018, **1**, 6865-6870.
4. Q. Wu, Q. Shao, Q. Li, Q. Duan, Y. Li and H. G. Wang, *ACS applied materials & interfaces*, 2018, **10**, 15642-15651.
5. G. Suo, D. Li, L. Feng, X. Hou, Y. Yang and W. Wang, *Journal of Electroanalytical Chemistry*, 2019, **833**, 113-118.

6. X. Zhao, W. Wang, Z. Hou, G. Wei, Y. Yu, J. Zhang and Z. Quan, *Chem Eng J*, 2019, **370**, 677-683.
7. D. Li, Q. Sun, Y. Zhang, L. Chen, Z. Wang, Z. Liang, P. Si and L. Ci, *ChemSusChem*, 2019, **12**, 1-13.
8. J. Chu, W. A. Wang, J. Feng, C. Y. Lao, K. Xi, L. Xing, K. Han, Q. Li, L. Song, P. Li, X. Li and Y. Bao, *Acs Nano*, 2019, DOI: 10.1021/acsnano.9b01773.
9. C. Chen, Y. Yang, X. Tang, R. Qiu, S. Wang, G. Cao and M. Zhang, *Small*, 2019, **15**, e1804740.
10. W. Miao, Y. Zhang, H. Li, Z. Zhang, L. Li, Z. Yu and W. Zhang, *Journal of Materials Chemistry A*, 2019, **7**, 5504-5512.
11. B. Jia, Q. Yu, Y. Zhao, M. Qin, W. Wang, Z. Liu, C.-Y. Lao, Y. Liu, H. Wu, Z. Zhang and X. Qu, *Adv Funct Mater*, 2018, **28**, 1803409.
12. L. Xing, Q. Yu, B. Jiang, J. Chu, C.Y. Lao, M. Wang, K. Han, Z. Liu, Y. Bao and W. Wang, *Journal of Materials Chemistry A*, 2019, **7**, 5760-5768.
13. H. Huang, J. Cui, G. Liu, R. Bi and L. Zhang, *Acs Nano*, 2019, **13**, 3448-3456.
14. C. Yang, J. Feng, F. Lv, J. Zhou, C. Lin, K. Wang, Y. Zhang, Y. Yang, W. Wang, J. Li and S. Guo, *Adv Mater*, 2018, **30**, e1800036.
15. Y. Liao, C. Chen, D. Yin, Y. Cai, R. He and M. Zhang, *Nano-Micro Letters*, 2019, **11**.
16. H. Wu, Q. Yu, C.Y. Lao, M. Qin, W. Wang, Z. Liu, C. Man, L. Wang, B. Jia and X. Qu, *Energy Storage Materials*, 2019, **18**, 43-50.
17. T. Jin, H. Li, Y. Li, L. Jiao and J. Chen, *Nano Energy*, 2018, **50**, 462-467.
18. Y. Li, C. Yang, F. Zheng, Q. Pan, Y. Liu, G. Wang, T. Liu, J. Hu and M. Liu, *Nano Energy*, 2019, **59**, 582-590.
19. C. Liu, S. Luo, H. Huang, Y. Zhai and Z. Wang, *ChemSusChem*, 2019, **12**, 873-880.
20. Z.Q Tong, R. Yang, S. Wu, D. Shen, T. Jiao, K. Zhang, W. Zhang and C. S. Lee, *Small*, 2019, 1901272.
21. F. Yang, H. Gao, J. Hao, S. Zhang, P. Li, Y. Liu, J. Chen and Z. Guo, *Adv*

*Funct Mater*, 2019, **29**, 1808291.

22. Y. Wu, S. Hu, R. Xu, J. Wang, Z. Peng, Q. Zhang and Y. Yu, *Nano letters*, 2019, **19**, 1351-1358.
23. K. Lei, C. Wang, L. Liu, Y. Luo, C. Mu, F. Li and J. Chen, *Angewandte Chemie*, 2018, **57**, 4687-4691.
24. Y. Tian, Y. An, S. Xiong, J. Feng and Y. Qian, *Journal of Materials Chemistry A*, 2019, **7**, 9716-9725.
25. Q. Yang, Z. Wang, W. Xi and G. He, *Electrochemistry Communications*, 2019, **101**, 68-72.
26. Y. Xu, C. Zhang, M. Zhou, Q. Fu, C. Zhao, M. Wu and Y. Lei, *Nat Commun*, 2018, **9**, 1720.
27. W. Yang, J. Zhou, S. Wang, W. Zhang, Z. Wang, F. Lv, K. Wang, Q. Sun and S. Guo, *Energy & Environmental Science*, 2019, **12**, 1605-1612.
28. J. Ding, H. Zhang, H. Zhou, J. Feng, X. Zheng, C. Zhong, E. Paek, W. Hu and D. Mitlin, *Adv Mater*, 2019, 1900429.
29. M. Chen, W. Wang, X. Liang, S. Gong, J. Liu, Q. Wang, S. Guo and H. Yang, *Advanced Energy Materials*, 2018, **8**, 1800171.
30. Y. Liang, C. Luo, F. Wang, S. Hou, S.C. Liou, T. Qing, Q. Li, J. Zheng, C. Cui and C. Wang, *Advanced Energy Materials*, 2019, **9**, 1802986.