Supporting Information

Quick one-pot synthesis of amorphous carbon-coated cobalt–ferrite twin elliptical frustums for enhanced lithium storage capability

Yang Xiang,[‡a] Hu Wu,[‡a] Kelvin H. L. Zhang,[b] Mike Coto,[b] Teng Zhao,[b] Sheng Chen,[a] Bitao Dong,[a] Shiyao Lu,[a]

Amr Abdelkader,[c] Yuzhen Guo,[d] Yanfeng Zhang,[a] Shujiang Ding,[a] Kai Xi[*b] and Guoxin Gao[*a]

[a], Department of Applied Chemistry, School of Science, Xi'an Jiaotong University, Xi'an 710049, P. R. China.
[b], Department of Materials Science and Metallurgy, University of Cambridge, Cambridge CB3 0FS, UK
[c], National Graphene Institute (NGI), University of Manchester, Booth Street East, Manchester, M13 9QS, UK
[d], College of Engineering, Swansea University, SA1 8EN, UK

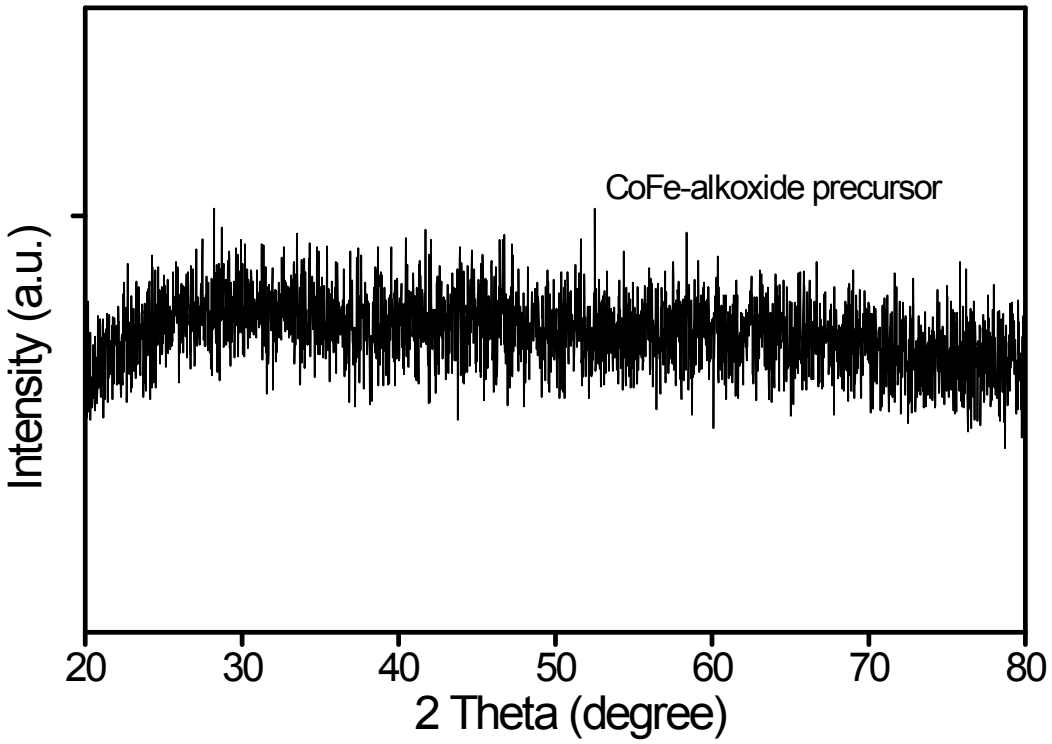

Figure S1. XRD pattern of as-prepared CoFe-alkoxide precursor

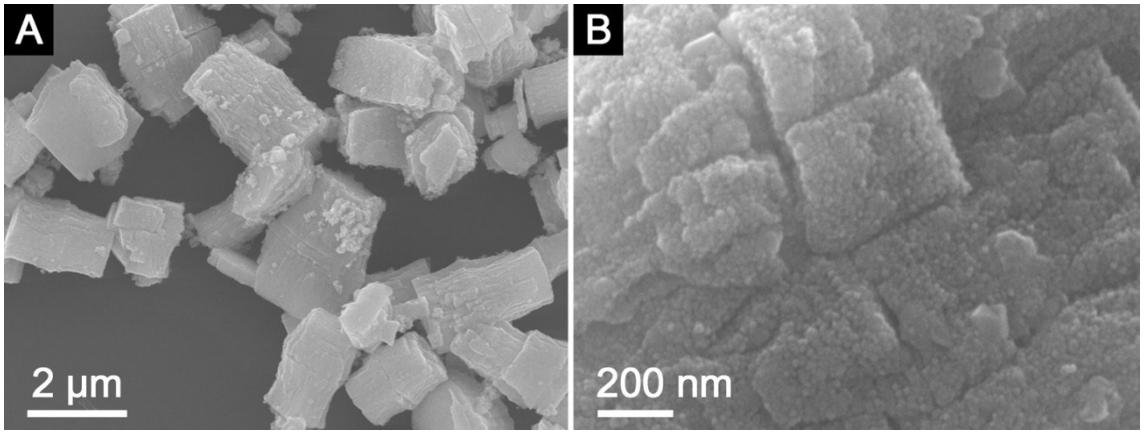

Figure S2. FESEM images of $CoFe_2O_4$ TEFs obtained after annealing the CoFe-alkoxide precursor in air at 500 ^oC with a heating rate of 1 $^oC\ min^{-1}$.

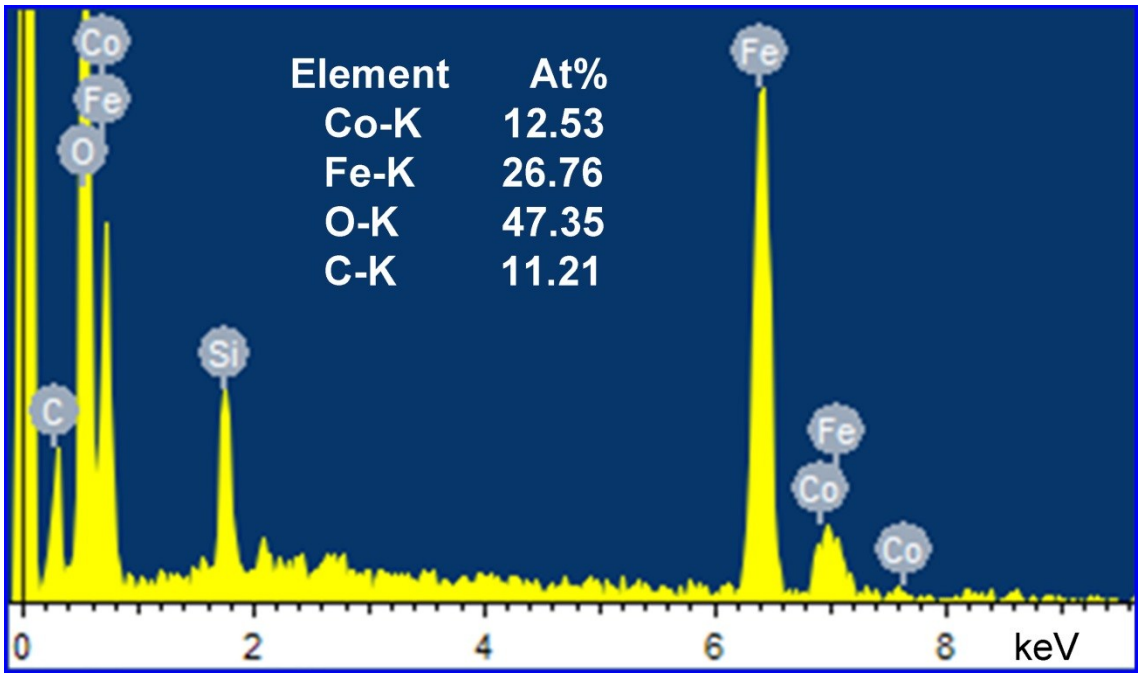

Figure S3. EDX pattern of as-prepared $CoFe_2O_4$@C TEFs.

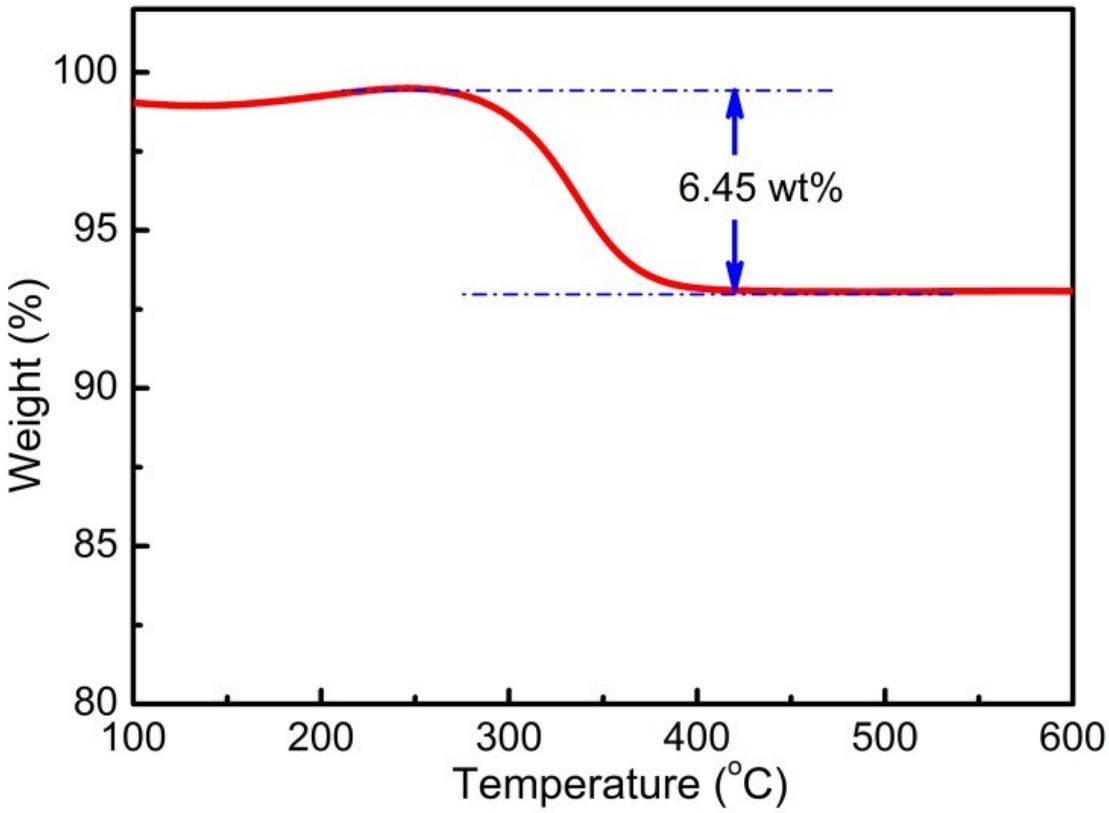

Figure S4. TGA curve of the as-prepared $CoFe_2O_4$@C TEFs in air between 100 and 600 °C with a heating rate of 10 °C min^{-1}.

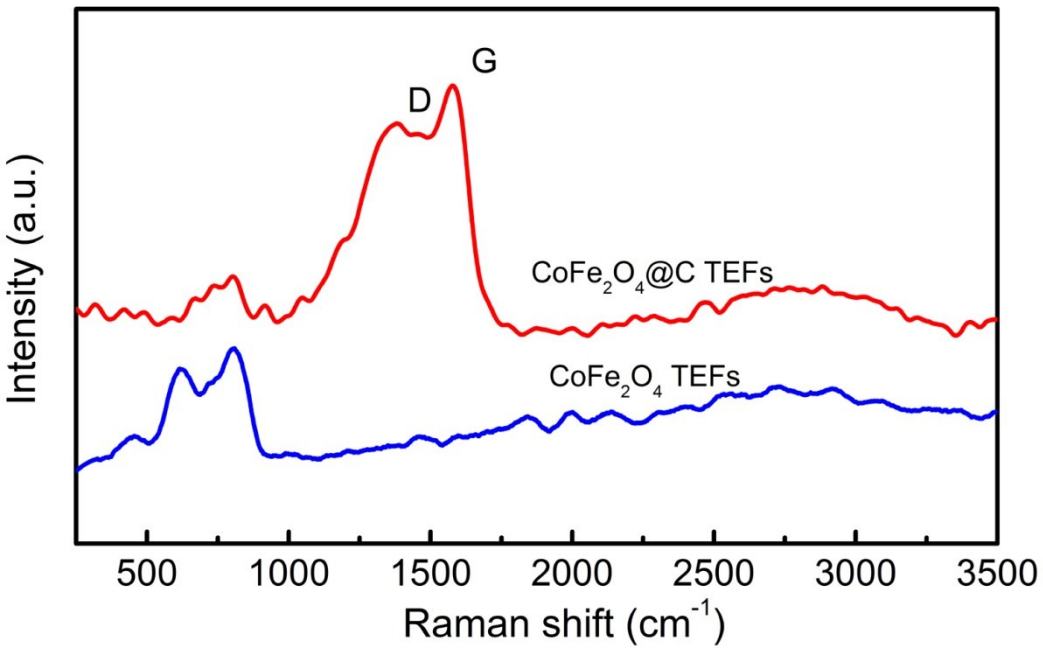

Figure S5. Raman spectroscopy of as-prepared $CoFe_2O_4$@C TEFs and $CoFe_2O_4$ TEFs.

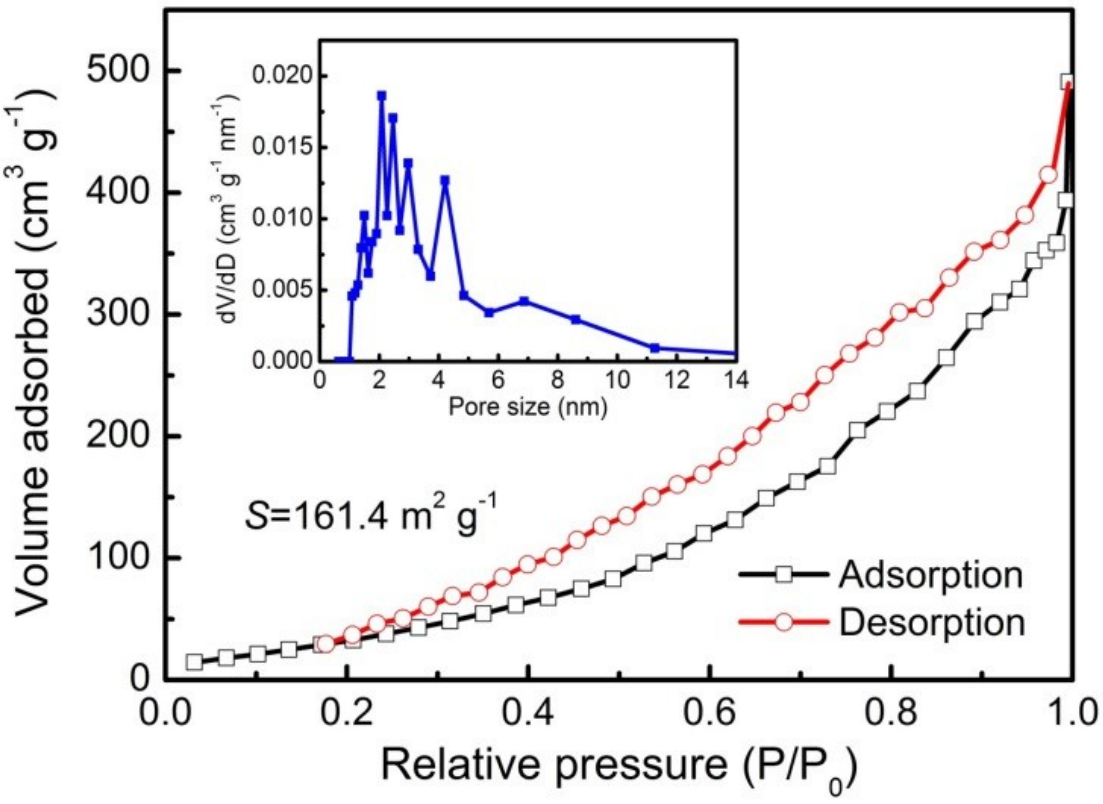

Figure S6. N_2 adsorption-desorption isotherm of the as-prepared $CoFe_2O_4$@C TEFs and the pore size distribution curve (inset) obtained by the BJH method.

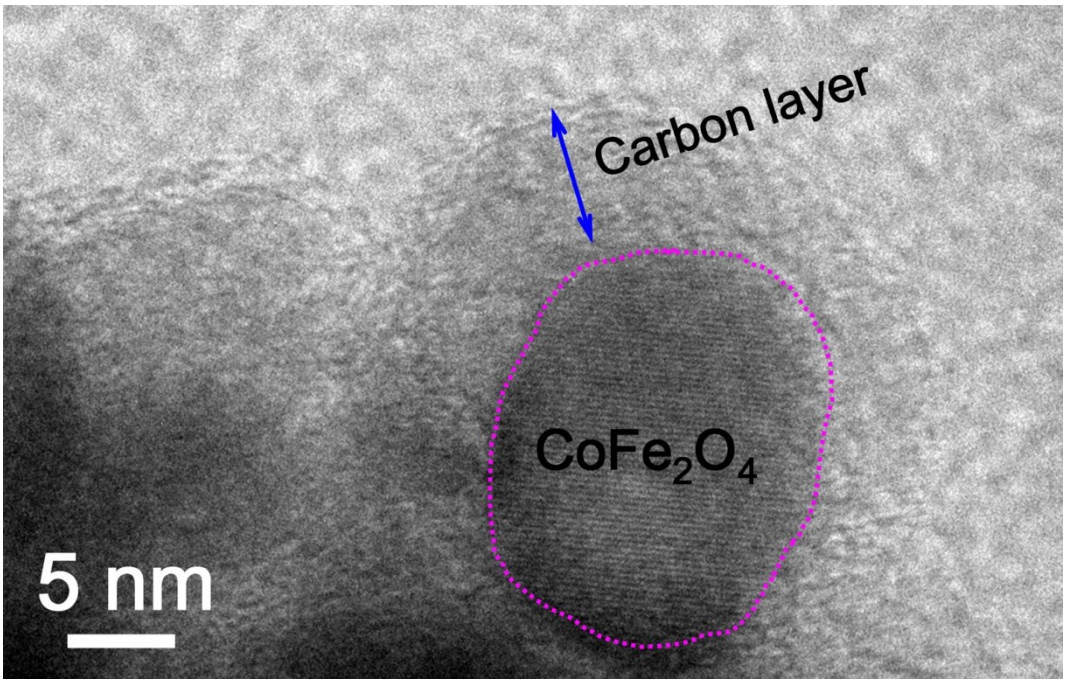

Figure S7. High resolution TEM image of as-prepared $CoFe_2O_4$@C TEFs.

Table S1. Electrochemical comparison with other reported $CoFe_2O_4$-based anodes for LIB.

Electrode materials	**Discharge capacity in the second cycle**	**Capacity retention after long cycles**	**Ref.**
$CoFe_2O_4$@C TEFs	823 mAh g^{-1} at 500 mA g^{-1}	91.4% after 600 cycles	This work
$CoFe_2O_4$@CNTs	801 mAh g^{-1} at 400 mA g^{-1}	99% after 50 cycles	1
$CoFe_2O_4$@rGO NPs	906 mAh g^{-1} at 100 mA g^{-1}	100.4% after 50 cycles	2
C@$CoFe_2O_4$@rGO NPs	956 mAh g^{-1} at 100 mA g^{-1}	96.8% after 50 cycles	3
$CoFe_2O_4$@rGO NPs	938 mAh g^{-1} at 1000 mA g^{-1}	69.5% after 50 cycles	4
Porous $CoFe_2O_4$ Octahedrons	722 mAh g^{-1} at 100 mA g^{-1}	96.4% after 50 cycles	5
$CoFe_2O_4$@rGO NPs	735 mAh g^{-1} at 800 mA g^{-1}	76.9% after 300 cycles	6
$CoFe_2O_4$@CNT NPs	1153 mAh g^{-1} at 200 mA g^{-1}	90.6% after 100 cycles	7
$CoFe_2O_4$@CNT NPs	712 mAh g^{-1} at 100 mA g^{-1}	82.2% after 350 cycles	8
$CoFe_2O_4$ Flowers	942 mAh g^{-1} at 200 mA g^{-1}	77.9% after 50 cycles	9
$CoFe_2O_4$ NTs	ca. 901 mAh g^{-1} at 50 mA g^{-1}	67.7% after 150 cycles	10
$CoFe_2O_4$@carbon cloth NWs	Ca. 1298 mAh g^{-1} at 500 mA g^{-1}	92.8% after 200 cycles	11
$CoFe_2O_4$ NSs	ca. 1301 mAh g^{-1} at 50 mA g^{-1}	88.2% after 30 cycles	12
Yolk–Shell $CoFe_2O_4$	900 mAh g^{-1} at 1000 mA g^{-1}	83.2% after 200 cycles	13
C@$CoFe_2O_4$ FITMNs	ca. 1036 mAh g^{-1} at 200 mA g^{-1}	67.6% after 150 cycles	14
$CoFe_2O_4$@rGO NPs	ca. 902 mAh g^{-1} at 100 mA g^{-1}	104.8 after 100 cycles	15

Reference

1. Fu, H.; Du, Z. J.; Zou, W.; Li, H. Q.; Zhang, C. Simple fabrication of strongly coupled cobalt ferrite/carbon nanotube composite based on deoxygenation for improving lithium storage. *Carbon* **2013,** *65*, 112-123.
2. Xia, H.; Zhu, D. D.; Fu, Y. S.; Wang, X. $CoFe_2O_4$-graphene nanocomposite as a high-capacity anode material for lithium-ion batteries. *Electrochim. Acta* **2012,** *83*, 166-174.
3. Zhang, M.; Yang, X.; Kan, X. F.; Wang, X.; Ma, L.; Jia, M. Q. Carbon-encapsulated $CoFe_2O_4$/graphene nanocomposite as high performance anode for lithium ion batteries. *Electrochim. Acta* **2013,** *112*, 727-734.
4. Li, S. M.; Wang, B.; Liu, J. H.; Yu, M. In situ one-step synthesis of $CoFe_2O_4$/graphene nanocomposites as high-performance anode for lithium-ion batteries. *Electrochim. Acta* **2014,** *129*, 33-39.
5. Fu, X. N.; Chen, D.; Wang, M.; Yang, Y. S.; Wu, Q. Z.; Ma, J. M.; Zhao, X. S. Synthesis of porous $CoFe_2O_4$ octahedral structures and studies on electrochemical Li storage behavior. *Electrochim. Acta* **2014,** *116*, 164-169.
6. Liu, S. Y.; Xie, J.; Fang, C. C.; Cao, G. S.; Zhu, T. J.; Zhao, X. B. Self-assembly of a $CoFe_2O_4$/graphene sandwich by a controllable and general route: towards a high-performance anode for Li-ion batteries. *J. Mater. Chem.* **2012,** *22* (37), 19738-19743.
7. Zhang, Z. L.; Wang, Y. H.; Zhang, M. J.; Tan, Q. Q.; Lv, X.; Zhong, Z. Y.; Su, F. B. Mesoporous $CoFe_2O_4$ nanospheres cross-linked by carbon nanotubes as high-performance anodes for lithium-ion batteries. *J. Mater. Chem. A* **2013,** *1* (25), 7444-7450.
8. Ren, S. H.; Zhao, X. Y.; Chen, R. Y.; Fichtner, M. A facile synthesis of encapsulated $CoFe_2O_4$ into carbon nanofibres and its application as conversion anodes for lithium ion batteries. *J. Power Sources* **2014,** *260*, 205-210.
9. Xiong, Q. Q.; Tu, J. P.; Shi, S. J.; Liu, X. Y.; Wang, X. L.; Gu, C. D. Ascorbic acid-assisted synthesis of cobalt ferrite ($CoFe_2O_4$) hierarchical flower-like microspheres with enhanced lithium storage properties. *J. Power Sources* **2014,** *256*, 153-159.
10. Wang, H. G.; Liu, D. P.; Li, Y. H.; Duan, Q. Single-spinneret electrospinning fabrication of $CoFe_2O_4$ nanotubes as

high-performance anode materials for lithium-ion batteries. *Mater Lett* **2016,** *172*, 64-67.

11. Zhao, S. H.; Guo, J. X.; Jiang, F.; Su, Q. M.; Du, G. H. Porous $CoFe_2O_4$ nanowire arrays on carbon cloth as binder-free anodes for flexible lithium-ion batteries. *Mater. Res. Bull.* **2016,** *79*, 22-28.
12. Yao, X. Y.; Kong, J. H.; Tang, X. S.; Zhou, D.; Zhao, C. Y.; Zhou, R.; Lu, X. H. Facile synthesis of porous $CoFe_2O_4$ nanosheets for lithium-ion battery anodes with enhanced rate capability and cycling stability. *RSC Adv.* **2014,** *4* (52), 27488-27492.
13. Ko, Y. N.; Park, S. B.; Lee, J. H.; Kang, Y. C. Comparison of the electrochemical properties of yolk-shell and dense structured $CoFe_2O_4$ powders prepared by a spray pyrolysis process. *RSC Adv.* **2014,** *4* (76), 40188-40192.
14. Wang, J. A.; Yang, G. R.; Wang, L.; Yan, W.; Wei, W. C@$CoFe_2O_4$ fiber-in-tube mesoporous nanostructure: Formation mechanism and high electrochemical performance as an anode for lithium-ion batteries. *J. Alloy. Compd.* **2017,** *693*, 110-117.
15. Qia, W.; Li, P.; Wu, Y.; Zeng, H.; Hou, L. T.; Kuang, C. J.; Yao, P.; Zhou, S. X. Facile synthesis of $CoFe_2O_4$ nanoparticles anchored on graphene sheets for enhanced performance of lithium ion battery. *Prog. Nat. Sci. Mater.* **2016,** *26* (5), 498-502.