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PII: S1385-8947(18)31812-6
DOI: https://doi.org/10.1016/j.cej.2018.09.095
Reference: CEJ 19934

To appear in: *Chemical Engineering Journal*

Received Date: 26 July 2018
Revised Date: 1 September 2018
Accepted Date: 12 September 2018

Please cite this article as: Q. Liu, X. Hong, X. Zhang, W. Wang, W. Guo, X. Liu, M. Ye, Hierarchically Structured Co_9S_8@$NiCo_2O_4$ Nanobrushes for High-Performance Flexible Asymmetric Supercapacitors, *Chemical Engineering Journal* (2018), doi: https://doi.org/10.1016/j.cej.2018.09.095

Hierarchically Structured Co_9S_8@$NiCo_2O_4$ Nanobrushes for High-Performance Flexible Asymmetric Supercapacitors

Qun Liu,[a] *Xiaodan Hong,*[a] *Xin Zhang,*[a] *Wei Wang,*[a] *Wenxi Guo,*[a] *Xiangyang Liu,**[ab] *Meidan Ye**[a]

[a]*Research Institute for Biomimetics and Soft Matter, Fujian Provincial Key Laboratory for Soft Functional Materials Research, Department of Physics, Xiamen University, Xiamen 361005, China*

[b]*Department of Physics, Faculty of Science, National University of Singapore, Singapore*

* Corresponding author: *mdye@xmu.edu.cn*, *liuxy@xmu.edu.cn*

Abstract

Hierarchically structured Co_9S_8@$NiCo_2O_4$ nanobrushes constructing by $NiCo_2O_4$ nanosheets grown on Co_9S_8 hollow nanoneedles are first fabricated on carbon cloth substrates via a multi-step route. Remarkably, such Co_9S_8@$NiCo_2O_4$ electrode processes multiplied electrochemical performance as compared to single Co_9S_8 and $NiCo_2O_4$ electrodes. It displays high-performance electrochemical behavior, achieving a specific capacitance of 1966 F g^{-1} at 1 A g^{-1} while maintaining excellent stability with about 92.9% capacitance retention after 5000 cycles. The flexible solid-state asymmetric upercapacitor based on this Co_9S_8@$NiCo_2O_4$ electrode exhibits a high specific capacitance of over 250 F g^{-1} at 1 A g^{-1}, and delivers a high energy density of 86 W h kg^{-1} at 792 W kg^{-1} and a maximum specific power of 11360 W kg^{-1} at 64 W h kg^{-1}. Moreover, the supercapacitor holds more than 84.2% capacitance retention after 10000 cycles at 10 A g^{-1} and demonstrates good durability after different deformation, suggesting its outstanding cycle stability and flexibility. Thus, the Co_9S_8@$NiCo_2O_4$ electrode with special heterogeneous structures shows the potential application in wearable energy storage devices.