Irradiation Synthesis of Nanostructured $FeSn_2$-carbon Nanofiber Composites as Highly Stable Anodes for Super-capacitor

Manman Zhang[1,2], Mingwu Fan[1], Tiaoqin Yu[1], Jiang Huang[1], Jun Yang[1], Long Zhao[1], Kangjun Xie[1,2], Wei Qi[1,2*]

[1]Institute of Applied Electromagnetic Engineering, Huazhong University of Science and Technology, Wuhan 430074, China

[2]School of Chemistry and Chemical Engineering, Huazhong University of Science and Technology, Wuhan 430074, China

[*]Corresponding author at: School of Chemistry and Chemical Engineering, Huazhong University of Science and Technology, Wuhan 430074, China (W. Qi)

Email address: qiwei@hust.edu.cn (W. Qi)

Energy storage materials are receiving tremendous attention and research interest due to the increasing concerns regarding the sustainable developments of energy, economy, and society, which are at the heart of high-efficiency energy storage devices [1-2]. Among the currently available electrical energy storage devices, super-capacitors have the largest potential practical application in future for the advantages of fast charge–discharge capability and high power density, but the low energy density restricts their forward to application in energy storage device [3-5]. This problem might be solved through selecting electrode materials. Therefore, in this work, we report a facile and scalable synthesis of nanostructured $FeSn_2$-carbon nanofiber composites *via* combining the electron beam irradiation and hydrothermal synthesis method. Through a serious of electrochemical experiments, the $FeSn_2$-carbon nanofiber composites showed outstanding electrochemical performance with minimal resistance (only about 0.9 Ω) in super-capacitor. The maximum capacitance is 250.0 F/g at the current density of 0.2 A/g, and even the capacitance of 100 F/g was obtained at the current density of 2 A/g. In addition, the $FeSn_2$-carbon nanofiber composites also displayed relative high energy density and excellent cycling stability as super-capacitor anodes. Therefore, the results of this work can open a new window for seeking suitable anode materials for super-capacitor.

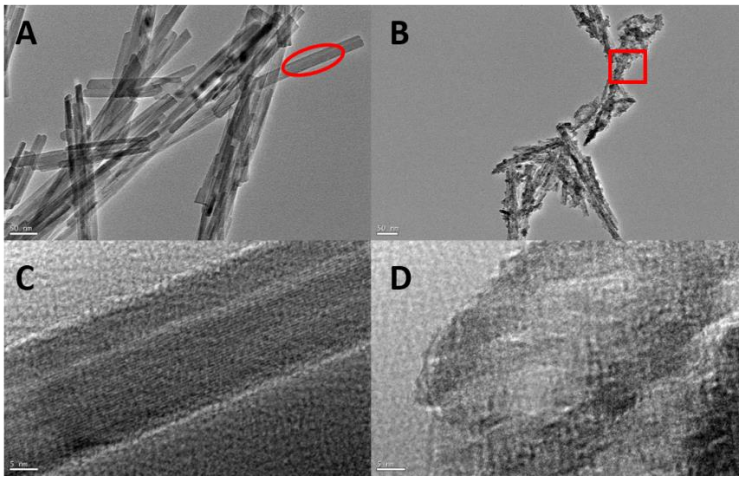

Figure 1 The TEM of carbon nanofibers (a) and $FeSn_2$-carbon nanofiber composites (b); (c) and (d) are HRTEM images for the red regions of (a) and (b), respectively.

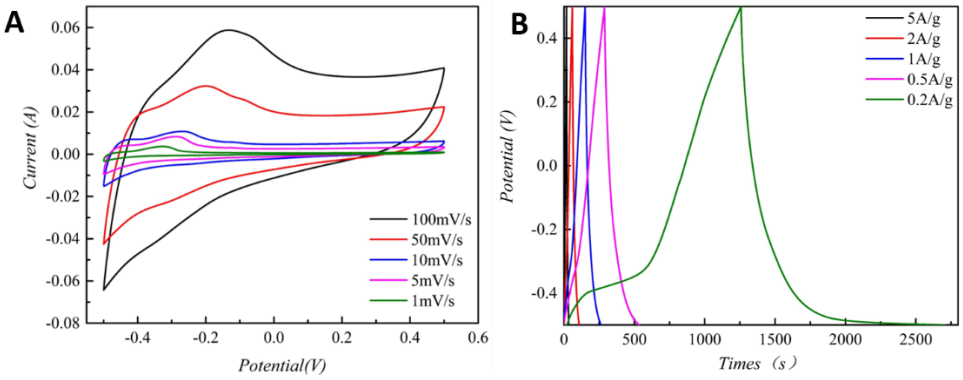

Figure 2 (a) cyclic voltammetry curves scanned at different rates of 1, 5, 10, 50 and 100 mV/s; (b) galvanostatic discharge/charge profiles tested at the current density of 0.2, 0.5, 1, 2 and 5 A/g.

Reference:

1. Zou Y, Wei Y, Wang G, et al. Nanopolymersomes with an ultrahigh iodine content for high-performance X-ray computed tomography imaging in vivo. Advanced Materials, 2017, 29(10).

2. Li Q, Chen L, Gadinski M R, et al. Flexible high-temperature dielectric materials from polymer nanocomposites. Nature, 2015, 523(7562):576.

3. Plylahan N, Letiche M, Barr M K S, et al. All-solid-state lithium-ion batteries based on self-supported titania nanotubes. Electrochemistry Communications, 2014, 43:121-124.

4. Elkady M F, Strong V, Dubin S, et al. Laser scribing of high-performance and flexible graphene-based electrochemical capacitors. Science, 2012, 335(6074):1326.

5. Abdelhamid A A, Yu Y, Yang J, et al. Generalized synthesis of metal oxide nanosheets and their application as Li-ion battery anodes. Advanced Materials, 2017, 29(32):1701427.