Data in Brief 20 (2018) 790–793

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Dataset analysis on Cu_9S_5 material structure and its electrochemical behavior as anode for sodium-ion batteries

Mingjun Jing [a], Fengliang Long [b], Luming Jing [c], Xiaopei Lv [c], Jiaheng Zhang [a], Tianjing Wu [a,d,*]

[a] College of Chemistry and Chemical Engineering, Hunan Institute of Science and Technology, Yueyang 414006, China
[b] College of Automotive Engineering, Hunan Industry Polytechnic, Changsha 410007, China
[c] First Senior High School of Pingdingshan, Pingdingshan 467000, China
[d] College of Chemistry and Chemical Engineering, Central South University, Changsha 410083, China

ARTICLE INFO

Article history:
Received 22 May 2018
Received in revised form
18 August 2018
Accepted 27 August 2018
Available online 1 September 2018

ABSTRACT

The data presented in this data article are related to the research article entitled “Facile Synthetic Strategy to Uniform Cu_9S_5 Embedded into Carbon: A Novel Anode for Sodium-Ion Batteries” (Jing et al., 2018) [1]. The related experiment details of pure Cu_9S_5 has been stated. The structure data of pure Cu_9S_5 and the electrochemical performance for sodium-ion batteries are described.

Specifications Table

Subject area	*Chemistry*
More specific subject area	*Sodium-ion batteries*
Type of data	*Figure*
How data was acquired	*X-ray diffraction (XRD, Rigaku D/max 2550 VB$^+$); CHI660B electrochemical analyzer (Shanghai Chenhua Instruments Co., Ltd.).*

DOI of original article: https://doi.org/10.1016/j.jallcom.2018.05.224
* Corresponding author at: College of Chemistry and Chemical Engineering, Hunan Institute of Science and Technology, Yueyang 414006, China.

https://doi.org/10.1016/j.dib.2018.08.168
2352-3409/

Data format	*Analyzed*
Experimental factors	*Samples, assembled coin cells metallic sodium foil as counter and reference electrode*
Experimental features	*XRD character of sample and CV performance of electrode material*
Data source location	*Yueyang, China*
Data accessibility	*The data is with this article.*
Related research article	[1] M. Jing, F. Li, M. Chen, J. Zhang, F. Long, L. Jing, X. Lv, T. Wu, X. Ji, Facile synthetic strategy to uniform Cu_9S_5 embedded into carbon: A novel anode for sodium-ion batteries, J. Alloy. Compd., 762 (2018) 473–479.

Value of the data

- Detailed experimental data might be used in the development of further experiments in a particular area.
- The summary of material properties can be utilized to compare together and easily accessed from the various applications.
- The CV curves could be used for more scientific analysis of various metal sulfide as anode for Na-ion batteries.

1. Data

In this data article, the detailed experimental method of pure Cu_9S_5 sample has been presented. The X-ray diffraction (XRD) pattern and Cyclic voltammetry (CV) files of as-prepared sample shown in Fig. 1, which is utilized to analysis the electrochemical performance of as-prepared material as anode for sodium-ion batteries.

2. Experimental design, materials, and methods

An ethylenediamine-assisted hydrothermal method has been utilized to prepare pure Cu_9S_5 nanomaterial, according to previous report [2]. The detailed experimental design is as follows. Firstly, 6.0 mL of anhydrous ethylenediamine was dissolved in 24.0 mL deionized water. 1.5 mmol of Cu

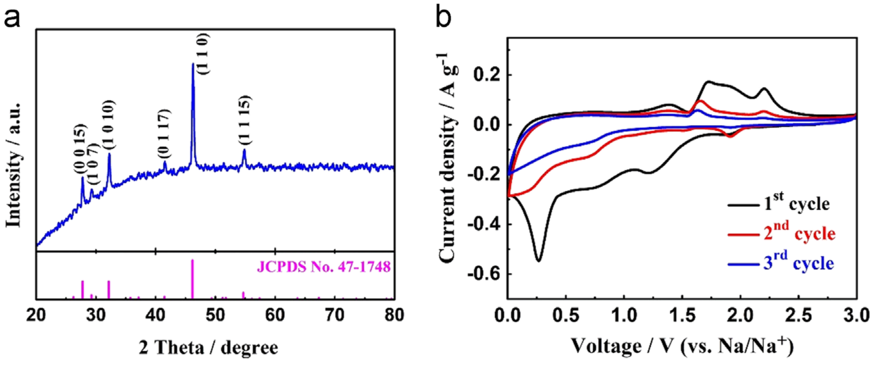

Fig. 1. (a) XRD pattern of pure Cu_9S_5. (b) CV files of pure Cu_9S_5 electrode at 0.2 mV s^{-1}.

$(NO_3)_2 \cdot 6H_2O$ was dissolved the above solution to form a blue solution with ultrasonic dispersion for 10 minutes. And then, 1.5 mmol of thiourea was introduced to the solution in batches, while the above solution is in the process of magnetic stirring. After 30 min, the color of mixture become deep blue. Then, this mixture system was transferred into a 50 mL Teflon-lined stainless steel autoclave and treated at 120 °C for 2 h. Furthermore, black precipitates were deposited on autoclave bottom after the temperature dropping down to room temperature naturally. The pale upper clear liquid was poured out. Then, the black precipitates were washed several times utilizing absolute ethanol and distilled water with (1:1 of the volume ratio). Finally, the products were further dried at 80 °C for 24 h, and the pure Cu_9S_5 was obtained.

X-ray diffraction (XRD) has been utilized to investigate the crystalline structure of pure Cu_9S_5. The detailed test parameters are based on Ref. [1]. Cyclic voltammetry (CV) tests of pure Cu_9S_5 has been measured on electrochemical working station (CHI 660B) through assembled CR2025 coin cells utilizing sodium foil as counter and reference electrode, according to previous report [1].

Fig. 1a displays the XRD pattern of as-obtained Cu_9S_5. The diffraction peaks of material matched well to the pure hexagonal Cu_9S_5 phase (JCPDS card No. 47–1748). The peaks at 27.7°, 29.2°, 32.3°, 41.5°, 46.3° and 54.9° correspond to the (0 0 15), (1 0 7), (1 0 10), (0 1 17), (1 1 0) and (1 1 15) crystal planes of hexagonal Cu_9S_5.

Furthermore, the CV profiles of Cu_9S_5 were tested with the potential range from 0.01 to 3.0 V (vs Na/Na^+) at 0.2 mV s^{-1}, which is shown in Fig. 1b. In the first cathodic scan, several oxidation peaks take place from 0.2 to 2.0 V, which is mainly attributed to the oxidation reactions of Cu_9S_5, the insertion process of Na^+ into electrode material, and the formation of solid electrolyte interphase (SEI) [1,3,4]. During the following anodic scanning, two major peaks at 1.65 and 2.12 V represent the electrochemical reaction from Cu and Na_2S to $Na_\alpha Cu_\beta S_\gamma$ and further changed into Cu_9S_5 [5]. These obvious redox peaks of pure Cu_9S_5 are present, illustrating the pure Cu_9S_5 active material mainly presents conversion reaction in the sodiation/desodiation process. Additionally, the microstructure analysis indicates that Cu_9S_5 electrode material could also exhibit little insertion/extraction mechanism like other metal sulfides [6,7].

Acknowledgments

This work was supported by the National Natural Science Foundation of China (No. 21701044, 51772092), Natural Science Foundation of Hunan Province China (Grant no. 2017JJ3097), Research Foundation of Education Bureau of Hunan Province, China (Grant no. 17A086), and National Training Programs of Innovation and Entrepreneurship for University Students of China (201710543004).

Transparency document. Supplementary material

Transparency document associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2018.08.168.

References

[1] M. Jing, F. Li, M. Chen, J. Zhang, F. Long, L. Jing, X. Lv, T. Wu, X. Ji, Facile synthetic strategy to uniform Cu_9S_5 embedded into carbon: a novel anode for sodium-ion batteries, J. Alloy. Compd. 762 (2018) 473–479.
[2] Y. Wang, F. Liu, Y. Ji, M. Yang, W. Liu, W. Wang, Q. Sun, Z. Zhang, X. Zhao, X. Liu, Controllable synthesis of various kinds of copper sulfides (CuS, Cu_7S_4, Cu_9S_5) for high-performance supercapacitors, Dalton Trans. 44 (2015) 10431–10437.
[3] J.-S. Kim, D.-Y. Kim, G.-B. Cho, T.-H. Nam, K.-W. Kim, H.-S. Ryu, J.-H. Ahn, H.-J. Ahn, The electrochemical properties of copper sulfide as cathode material for rechargeable sodium cell at room temperature, J. Power Sources 189 (2009) 864–868.

[4] T. Wu, C. Zhang, H. Hou, P. Ge, G. Zou, W. Xu, S. Li, Z. Huang, T. Guo, M. Jing, X. Ji, Dual functions of potassium antimony(III)-tartrate in tuning antimony/carbon composites for long-life Na-ion batteries, Adv. Funct. Mater. (2018) 1705744. https://doi.org/10.1002/adfm.201705744.
[5] H. Li, Y. Wang, J. Jiang, Y. Zhang, Y. Peng, J. Zhao, CuS microspheres as high-performance anode material for Na-ion batteries, Electrochim. Acta 247 (2017) 851–859.
[6] J. Li, Y. Fu, X. Shi, Z. Xu, Z. Zhang, Urchinlike ZnS microspheres decorated with nitrogen-doped carbon: a superior anode material for lithium and sodium storage, Chemistry 23 (2017) 157–166.
[7] Y. Zhao, L.P. Wang, M.T. Sougrati, Z. Feng, Y. Leconte, A. Fisher, M. Srinivasan, Z. Xu, A review on design strategies for carbon based metal oxides and sulfides nanocomposites for high performance Li and Na ion battery anodes, Adv. Energy Mater. 7 (2017) 1601424.