材料研究学报 >>2012 >>26 >>(1)

材料研究学报 2012, 26(1) 73-77 DOI: ISSN: 1005-3093 CN: 21-1328/TG

研究论文

微米螺旋碳纤维的电容特性

殷大根, 朱亚波, 杜勇, 刘晓霞, 刘章生

中国矿业大学材料科学与工程学院 徐州 221116

摘要: 用CVD法合成微米螺旋碳纤维(carbon microcoils, CMCs), 用硝酸和KOH等对其进行纯化和活化处理, 用扫描电镜(SEM)、光学显微镜观察其形貌, 用X--射线能谱仪分析反应后催化剂成分, 并采用恒流充放电、循环伏安、 交流阻抗等电化学方法分析CMCs超级电容器性能。结果表明, 在50 mA•g^{-1}电流密度条件下, 初始CMCs产物的比电容为12.7 F•g^{-1}, 纯化处理后的比电容为41.4 F•g^{-1}, 活化处理后则达到111.1 F•g^{-1}, 为处理前的8.75倍。表明纯化特别是活化处理使其电容性能显著提高。

关键词: 无机非金属材料 微螺旋碳纤维 超级电容器 比电容

Electrochemical Capacitance Performance of Carbon Microcoils

YIN Dagen, ZHU Yabo, DU Yong, LIU Xiaoxia, LIU Zhangsheng

School of Materials Science and Engineering, China University of Mining and Technology, Xuzhou 221116

Abstract: Carbon microcoils (CMCs) were prepared by CVD, and then were purified and activated with nitric acid and KOH. The morphology of CMC samples with their catalyzer were characterized by means of scanning electron microscope, optical microscope and X-ray spectrometer, respectively. CMCs supercapacitors were characterized by charge-discharge, cyclic voltammetry(CV) and electrochemical impedance spectroscopy(EIS). The results show that in the current density of 50 mA • g^{-1}, the electrochemical capacity of no-disposed CMCs, purification CMCs and activation CMCs are 12.7 F • g^{-1}, 41.4 F • g^{-1} and 111.1 F • g^{-1} (about 8.75 times before the disposed), respectively. It can be concluded that the capacity of CMCs supercapacitors can be improved by purification and activation.

Keywords: inorganic non-metallic materials carbon microcoils supercapacitor electrochemical capacity

收稿日期 2011-11-14 **修回日期** 2011-12-05 **网络版发布日期** 2012-02-10

DOI:

基金项目:

国家大学生创新性实验计划和中国矿业大学创新能力提升基金2011XK07资助项目。

通讯作者: 朱亚波

作者简介:

通讯作者E-mail: zhuyabo@163.com

参考文献:

[1] T.Hayashida, L.Pan, Y.Nakayama, Mechanical and electrical properties of carbon tubule nanocoils, Physica B, 323, 352(2002)

[2] S.Motojima, X.Chen, S.Yang, M.Hasegawa, Properties and potential applications of carbon microcoils/nanocoils, Diam. Relat. Mater., 13, 1989(2004)

[3] K.Yoshimura, K.Nakano, T.Miyake, Y.Hishikawa, S.Motojima, Effectiveness of carbon microcoils as a reinforcing material for a polymer matrix, Carbon, 44(2006), 2833 (2006)

[4] K.-T.Lau, M.Lu, K.Liao, Improved mechanical properties of coiled carbon nanotubes reinforced epoxy nanocomposites, Composites Part A, 37, 1837(2006)

[5] S.Motojima, X.Chen, Preparation and characterization of carbon microcoils (CMCs), Bull. Chem. Soc. Jpn., 80(3), 449(2007)

[6] WU Fayu, DU Jinhong, LIU Chenguang, LI Lixiang, CHENG Huiming, Themicrostructure and energy storage characteristics of micro-coiled carbon fibers , New Carbon Materials, 19(2), 81(2004)

[7] M.J.Hanus, A.T.Harris, Synthesis, characterisation and applications of coiled carbon nanotubes, J. Nanosci. Nanotechnol., 10, 2261(2010)

[8] P.Simon, Y.Gogotsi, Materials for electrochemical capacitors, Nat. Mater., 7, 845(2008)

[9] Lili Zhang, X.S.Zhao, Carbon-based materials as supercapacitor electrodes, Chem. Soc. Rev., 38, 2520(2009)

[10] Lili Zhang, Rui Zhou, X.S.Zhao, Graphene-based materials as supercapacitor electrodes, J. Mater. Chem., 20, 5983(2010)

[11] Yan Wang, Zhiqiang Shi, Yi Huang, Yanfeng Ma, Chengyang Wang, Mingming Chen, Yongsheng Chen, Supercapacitor devices based on graphene materials, J. Phys. Chem. C, 113(30), 13103(2009)

[12] WAN Chuanyun, WANG Lijun, SHEN Shaodian, ZHU Xian, Effect of synthesis routes on the performances of MnO2 for electrochemical capacitors, Acta Chim. Sin., 67(14), 1559(2009)

[13] LI Xiaohui, LI Yunyu, GANWeiping, OU Dingbin, Recent advances of oxide electrode materials of supercapacitor, J. Guangdong Non-ferrous Met., 16(1), 62(2006)

[14] P.Sivaraman, R.K.Kushwaha, K.Shashidhara, V.R.Hande, A.P.Thakur, A.B.Samui, M.M.Khandpekar, All solid supercapacitor based on polyaniline and crosslinked sulfonated poly[ether ether ketone], Electrochim. Acta, 55, 2451(2010)

[15] C.A.Amarnath, J.H.Chang, D.Kim, R.S.Mane, S.H.Han, D.Sohn, Electrochemical supercapacitor application of electroless surface polymerization of polyaniline nanostructures, Mater. Chem. Phys., 113, 14(2009)

[16] J.L.Liu, M.Q.Zhou, L.Z.Fan, P.Li, X.H.Qu, Porous polyaniline exhibits highly enhanced electrochemical capacitance performance, Electrochim Acta, 55, (2010)

[17] ZHANG Xiaobo, CHEN Minghai, ZHANG Xiaogang, LI Qingwen, Preparation of porous carbon nano fibers by eiectrospinning and their electrochemical capacitive behavior, Acta Phys. Chim. Sin., 26(12), 3169(2010)

[18] JI Qianqian, GUO Peizhi, ZHAO Xiusong, Preparation of chitosan-based porous carbons and their application as electrode materials for supercapacitors, Acta Phys. Chim. Sin., 26(5), 1254(2010)

[19] Xin Zhao, Bryan T T Chu, Belen Ballesteros, Weiliang Wang, Colin Johnston, John M Sykes, Patrick S Grant,Spray deposition of steam treated and functionalized single-walled and multi-walled carbon nanotube films for supercapacitors, Nanotechnology, 20, 065605(2009)

[20] Cunjiang Yu, Charan Masarapu, Jiepeng Rong, Bingqin Wei, Hanqing Jiang, Stretchable supercapacitors based on buckled single-walled carbon nanotube

macrofilms, Adv. Mater., 21, 4793(2009)

[21] Lanjuan Wang, Chunzhong Li, Feng Gu, Chuanxiang Zhang, Facile flame synthesis and electrochemical properties of carbon nanocoils, Journal of Alloy and Compounds, 473, 351(2009)

[22] S.Motojima, H.Iwanaga, T.Hashishin, T.Kojima, T.Tsuda, Preparation of carbon microcoils/nanocoils and ceramic microcoils and their properties, Micromechatronics and Human Science, 1(2002)

[23] XU Bin, ZHANG Hao, CAO Gaoping, ZHANG Wenfeng, YANG Yusheng, Carbon materials for supercapacitors, Progress in Chemistry, 23(2/3), 605(2011)

[24] Yonggang Wang, Yongyao Xia, Hybrid aqueous energy storage cells using activated carbon and lithiumintercalated compounds I. The C/LiMn2O4 system, J. Electrochem. Soc, 153(2), 540(2006)

[25] T.C.Girija, M.V.Sangaranarayanan, Analysis of polyaniline-based nickel electrodes for electrochemical supercapacitors, J. Power Sources, 156(2), 705(2006)

本刊中的类似文章

1．曹晓晖 陈威宏 刘宇 孙杰 曹晓晖 王文举 于名讯.二次化学共沉淀法制备片状钡铁氧体的形成历程及磁性能研究[J]. 材料研究学报, 2012,26(1): 107-112

2．豆喜华 赵韦人 宋恩海 周国雄 易春雨 周民康.紫外激发蓝色荧光粉$Sr_{2-x-y}B_5O_9Cl:xEu^{2+},yTb^{3+}$的合成和发光性能[J]. 材料研究学报, 2012,26(1): 96-100

3．杨武涛 杨卫华 付芳.PEG/CPB复配改性二氧化铅电极的制备和性能[J]. 材料研究学报, 2012,26(1): 8-12

4．刘义 李海金 张清 刘厚通.钙钛矿型热电氧化物$Y_{0.95}R_{0.05}CoO_3$ (R=Ca, Sr, Ba)的制备和热电性能[J]. 材料研究学报, 2012,26(1): 31-36

5．薛文斌 金乾 杜建成 华铭 吴晓玲.不锈钢表面阴极微弧电沉积氧化铝膜层的性能[J]. 材料研究学报, 2012,26(1): 21-25

6．朱德如 刘先松 胡锋 JOSE Luis Menendez.明显增强的镧掺杂锶铁氧体的磁光克尔效应[J]. 材料研究学报, 2012,26(1): 91-95

7．王珉 赵军 艾兴 刘继刚.含有烧结助剂的复相陶瓷材料烧结过程的元胞自动机模拟[J]. 材料研究学报, 2011,25(6): 618-624

8．檀雨默 张爱波 郑亚萍 兰岚 陈伟.具有固--液转变的磁性Fe_3O_4纳米流体的制备、结构及性能[J]. 材料研究学报, 2011,25(6): 561-565

9．魏晓玲 杨晖 沈晓冬.TiO2掺杂对Na-β"-Al2O3性能的影响[J]. 材料研究学报, 2011,25(6): 597-601

10．吴燕飞 黄英 张银铃 牛磊.Me2--W型钡铁氧体的制备及其电磁性能研究[J]. 材料研究学报, 2011,25(6): 607-612