Materials Today Energy 10 (2018) 118–125

Contents lists available at ScienceDirect

Materials Today Energy

journal homepage: www.journals.elsevier.com/materials-today-energy/

Tridimensional few-layer graphene-like structures from sugar-salt mixtures as high-performance supercapacitor electrodes

Housseinou Ba [a, *, 1], Wei Wang [a, 1], Giulia Tuci [b, c], Sergey N. Pronkin [a], Caroline Weinberg [a], Lam Nguyen-Dinh [d], Giuliano Giambastiani [a, b, e, **], Cuong Pham-Huu [a, ***]

[a] *Institute of Chemistry and Processes for Energy, Environment and Health (ICPEES), UMR 7515 CNRS-University of Strasbourg (UdS), 25, rue Becquerel, 67087, Strasbourg Cedex 02, France*
[b] *Institute of Chemistry of OrganoMetallic Compounds, ICCOM-CNR, Via Madonna del Piano, 10, 50019, Sesto Fiorentino, Florence, Italy*
[c] *Department of Chemistry "Ugo Schiff", University of Florence, 50019, Sesto Fiorentino, Italy*
[d] *The University of Da-Nang, University of Science and Technology, 54, Nguyen Luong Bang, Da-Nang, Viet Nam*
[e] *Kazan Federal University, 420008, Kazan, Russian Federation*

A R T I C L E I N F O

Article history:
Received 2 May 2018
Received in revised form
18 August 2018
Accepted 24 August 2018
Available online 8 September 2018

Keywords:
3D graphene-like materials
Salt templating method
Chemical activation
Natural C-sources
Supercapacitors

A B S T R A C T

This work describes a straightforward approach to the production of highly-performing and cost-effective C-based materials for energy storage application while proposing an original and effective method to the control of the final material morphology. Indeed, robust few-layer graphene-like and highly open-cell structures have been prepared by a modified chemical activation procedure starting from costless sugar/salt mixtures. The as-prepared C-samples ensure high ion-accessible surface area and low ion transport resistance, two key features for the fabrication of effective electrochemical double layer supercapacitors. A selected sample from this series exhibits high specific capacitance (C_g) (312 and 234 F g^{-1} at 0.5 and 50 A g^{-1}, respectively, in 0.5 M H_2SO_4), particularly at high current density values, along with excellent cycling stability and C_g retention for increasing charge–discharge rates.

1. Introduction

The ever-growing need of reducing fossil fuels consumption and greenhouse gas emissions are commonly recognized as priorities to fight against global warming and related climate change phenomena while addressing the objectives of a modern circular energy economy [1]. The production of electricity from renewable resources along with the development of highly-performing and cost-effective energy storage devices are among the most promising solutions to rapidly accomplish these challenging goals. To this end, batteries and supercapacitors have rapidly emerged as the main actors of a world economy based on the large-scale renewable energy management and storage [2–5]. In recent years, supercapacitors based on electrical double layer (EDL) charge storage have attracted the interest of chemists, physics and engineers as high power density and long-lifecycle devices, suitable for bridging the power/energy gap between batteries (featured by high energy but low power) and conventional capacitors (featured by high power but low energy). As far as energy density is concerned, research in design and synthesis of new electrodes and electrolytes has boosted progresses in EDL technology thus providing devices with steadily increasing performance (high power density and long-term life under operating conditions) [6–10]. Microporous carbons (pure or doped) are prominent electrode materials in EDL capacitors because of their high electrical conductivity, essential for power applications, and large specific surface area (SSA), necessary for enhancing capacitance. They can be derived from natural and abundant sources and prepared in a wide variety of textures (*i.e.* powders, fibers, nanotubes, sheets, monoliths and nanospheres just

* Corresponding author. Institute of Chemistry and Processes for Energy, Environment and Health (ICPEES), UMR 7515 CNRS-University of Strasbourg, France.
** Corresponding author. Institute of Chemistry of OrganoMetallic Compounds, ICCOM-CNR, Via Madonna del Piano, 10, 50019 Sesto Fiorentino, Florence, Italy.
*** Corresponding author. Institute of Chemistry and Processes for Energy, Environment and Health (ICPEES), UMR 7515 CNRS-University of Strasbourg, France
E-mail addresses: h.ba@unistra.fr (H. Ba), giuliano.giambastiani@iccom.cnr.it (G. Giambastiani), cuong.pham-huu@unistra.fr (C. Pham-Huu).
[1] These authors have equally contributed to this work.

https://doi.org/10.1016/j.mtener.2018.08.015
2468-6069/