Effect of pore texture on performance of activated carbon supercapacitor electrodes derived from olive pits

Edurne Redondo, Javier Carretero-González, Eider Goikolea, Julie Ségalini, Roman Mysyk*

CIC Energigune, Arabako Teknologi Parkea, Albert Einstein 48, 01510 Mirano, Spain

ARTICLE INFO

Article history:
Received 2 December 2014
Received in revised form 27 January 2015
Accepted 1 February 2015
Available online 3 February 2015

Keywords:
Supercapacitors
microporosity
activated carbon
biomass

ABSTRACT

Activated carbon electrodes for electrochemical capacitors have been prepared by the chemical activation of a natural renewable and by-product material precursor – olive pits – from the olive oil production industry. The careful adjustment of the synthesis conditions has allowed synthesizing a series of microporous carbon electrodes with an optimized microporosity, enabling a gravimetric and volumetric capacitance in basic aqueous medium up to 260 Fg⁻¹ and 140 Fcm⁻³, respectively, with good rate capability. A relation amongst capacitance, specific surface area, accessible average pore size and effective dielectric permittivity has been established, demonstrating that there is not just a single parameter decisively impacting the capacitance value. The collective analysis of experimental data suggests that solvation imposes an optimum pore size for each ion with regard to rate capability; moderate solvation contributes to enhancing capacitance in pores slightly exceeding solvated ion size while excessive solvation deteriorates the high-rate response of supercapacitor electrodes having pores much wider than ion size.

© 2015 Elsevier Ltd. All rights reserved.

* Corresponding author. Fax: +34 94 529 71 08.
E-mail address: mysyk@gmail.com (R. Mysyk).

http://dx.doi.org/10.1016/j.electacta.2015.02.006
0013-4686/© 2015 Elsevier Ltd. All rights reserved.

Acknowledgments

The work was supported by the Basque Government under the Etorrek Energigune’12 Program. The kind donation of crushed olive pit samples from AESA (Agropecuaria Ecológica Sierra de Alcaraz, Albacete, Spain) is gratefully acknowledged. The authors also thank Dr. Oleksandr Bondarchuk from CIC Energigune for taking XPS spectra and Dr. Iñaki Orue from the University of The Basque Country for his support and guidance during the measurement of electrical conductivity.