Olive leave-derived hard carbon materials for Li/Na-ion battery and supercapacitor applications

Hamideh Darjazi*, Roberto Tossici, Leonardo Sbrascini, Antunes Staffolani, Francesco Nobili.

Scuola di Scienze e Tecnologie – Sezione Chimica, Università di Camerino, Via S. Agostino 1, 62032 Camerino (Italy) * Hamideh Darjazi, e-mail hamideh.darjazi@unicam.it

Some of the most practical technologies for storing and converting electrochemical energy include Li-ion batteries (LIBs), Na-ion batteries (NIBs) and electrochemical supercapacitors (ES) 1, 2 . LIBs are the most developed energy storage devices which are often used in portable electronics, in electric vehicles and stationary battery storage systems. NIBs are commonly used in large scale electrical energy storage 3 , and have drawn significant attention as a potential alternative for LIBs, despite their lower performance, because of to the lower cost, similar electrochemical properties and higher abundance of sodium. ESs complement batteries by providing back up power supplies and the necessary power for acceleration and brake energy in hybrid electric vehicles 3 .

The market is starting to understand it can create value by reusing and recycling products in a closed loop whereby they do not become waste, but key resources again 3 . In this context, hard carbons (non-graphitizable carbons) which are produced from pyrolysis of polymers, combustion of saccharides and biomass

precursors are considered as promising electrode materials, due to their ability to provide high energy density for batteries and high power density for supercapacitors 4 . In the present study, hard carbon is synthesized through chemical acid activation of olive leaves, a largely available by-product of table olive and olive oil industries. Structural and morphological characterization is shown, together with the evaluation of the lithium/sodium intercalation capabilities in batteries and the charge storage ability in supercapacitors, by cyclic voltammetry, charge/discharge cycles and electrochemical impedance spectroscopy.

The electrode material for NIBs demonstrates promising performances with a high discharge capacity of 270 mAh/g at 1C. As LIB anode, the material delivers a reversible discharge capacity of 500 mAh/g at 1C. When used for ESs, the material shows a high specific capacitance of 180 F/g at the scan rate of 1 mVs^{-1} and a remarkable capacity retention of 80 % after 20000 cycles. The good electrochemical performances indicate that this low-cost material could be a promising candidate material for the investigated applications.

References

[1] J. Ni, Y. Haung, L. Gao. J. Power Sources, 223, (2013), 306-311.

[2] H. Darjazi, S. S. Hosseiny Davarani, H. R. Moazami, T.Yousefi, F. Tabatabaei, Progress in Natural Science: Materials International 26 (2016) 523–527.

[3] J. Ajuria, E. Redondo, M. Arnaiz, R. Mysyk, T. Rojo, E. Goikolea, J. Power Sources, 359, (2017), 17-26.

[4] N. Wang, Q. Liu, B. Sun, J. Gu, B. Yu, W. Zhang, D. Zhang, Sci. Rep., (2018), 1-8.