When comparing the capacitance values obtained by DLC Supra 30, one can see the advantage of walnut shell based carbon obtained by mild phosphoric activation exhibiting around 70% capacitance enhancement. Hence, high temperature treatment of walnut shell precursor with mild H_3PO_4 results in high surface area carbon perfectly adapted for application as electrode material for realizing electrochemical capacitors in 1 $mol \cdot L^{-1}$ Li_2SO_4.

4. Conclusions

Carbons produced from the walnut shell activated by H_3PO_4 at 400 °C are characterized by highest specific surface area which exceeds 2000 $m^2 \cdot g^{-1}$. Despite a well-developed porosity this type of carbonaceous materials are not able to be utilized as electrode materials for ECs due to the poor capacitive traces and high electrical resistivity. Increasing of activation temperature up to 800 °C improves electrochemical performance, but CV shape is not rectangular suggesting the hindrance to ionic movement inside the porosity of carbon electrodes. Furthermore the release of elemental phosphorus taking place during pyrolysis at high temperatures limits the practical importance of this method. As an alternative, it is proposed to use the thermal post-treatment of H_3PO_4-activated walnut shell at 800 °C which results in high specific surface area of carbon material. This approach makes possible to keep high values of porous texture without its excessive shrinkage and to produce carbon materials perfectly adapted for the charge storage in supercapacitors. This method is highly efficient and also economically feasible, since the post-treated materials are based on carbons produced at low temperatures. Supercapacitors constructed by implementing these carbons in 1 $mol \cdot L^{-1}$ Li_2SO_4 exhibit square-shape CVs, symmetric GCPL curves, low resistance and excellent capacitance retention during 5000 galvanostatic charge/discharge cycles at 1.5 V. Such superior electrochemical performance suggests that post-treatment of carbons (after H_3PO_4 activation) leads to developed porous texture appropriate for charge storage applications.

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