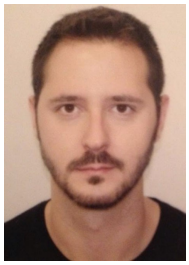
Batteries & Supercaps

Cover Profile
doi.org/10.1002/batt.202200071

Chemistry Europe
European Chemical Societies Publishing

www.batteries-supercaps.org

Monodisperse Porous Carbon Nanospheres with Ultra-High Surface Area for Energy Storage in Electrochemical Capacitors



Dr. Noel Díez

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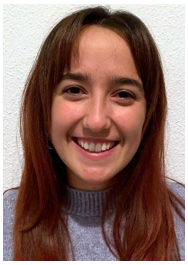

Alba Fombona-Pascual

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Invited for this month's cover picture is the group of Dr. Noel Díez. The Front Cover illustrates the use of monodisperse, highly porous carbon nanoparticles derived from polypyrrole as the electrode material in high power supercapacitors. The highly porous nanoparticles were employed to construct supercapacitors with practical mass loadings that showed a fast response in different types of electrolyte systems. Read the full text of the Article at 10.1002/batt.202100169.

What prompted you to investigate this topic/problem?

Energy storage is a key tool for the change of paradigm we must tackle in our energy system. Improving the performance of energy storage devices such as supercapacitors is essential for fulfilling the requisites of many expected applications. In this regard, we must improve the energy density that the supercapacitors can provide at high rates. Reducing the particle size of the porous carbon particles (the preferred electrode material) improves their ion transport properties, given that their shorter ion diffusion pathways allow an unimpeded adsorption and desorption of electrolyte ions. The production of highly porous carbon nanoparticles suitable for high power supercapacitors is not an easy task and so it has been scarcely reported. In this work, we address this challenge adopting a simple and sustainable synthetic route.

What was the biggest challenge (on the way to the results presented in this paper)?

The most important challenge we faced was achieving a large porosity development while maintaining the morphology of the nanoparticles. Direct chemical activation of polypyrrole nanoparticles using common activating agents leads to the coalescence of the particles, whilst pre-carbonization of the polymeric nanoparticles leads to limited pore developments. We have found that $KHCO_3$ acts as a benign activating agent that preserves the morphology of the nanoparticles and yet generates a large number of micropores within the particles, beating in this way the widely exploited but corrosive and harmful KOH.

What is the most significant result of this study?

The direct activation of polypyrrole nanoparticles with $KHCO_3$ leads to monodisperse, high surface nanoparticles with a pore size distribution that can be finely tuned from purely microporous to micro-mesoporous just by varying the temperature of the one-step carbonization/activation treatment. This allows to adjust their textural characteristics to different electrolyte systems, maximizing the energy and power of the supercapacitors.