ISGC 2022

N°1060 / PC
TOPIC(s) : Energy / Polymers or composites

OPTIMIZATION OF SUSTAINABLE POLYMERS FOR ELECTRODES OF SODIUM DUAL-ION BATTERIES

AUTHORS

Ana ARENILLAS / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO
Ana B. GARCIA / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO
Rosa M. TARAZONA / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO
M. Antonia DIEZ / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO
Roberto GARCIA / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO
Elena RODRIGUEZ / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO
M. Antonia LOPEZ / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO
Ignacio CAMEAN / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO
Natalia REY-RAAP / UNIVERSIDAD DE OVIEDO - CINN-CSIC, AVDA DE LA VEGA 4-6, EL ENTREGO
Nuria CUESTA / CINN-CSIC, AVDA DE LA VEGA 4-6, EL ENTREGO
Belen LOBATO / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO
Samantha L. FLORES-LOPEZ / INCAR-CSIC, FRANCISCO PINTADO FE 26, OVIEDO

PURPOSE OF THE ABSTRACT

The development of innovative materials obtained in a sustainable way within the framework of a circular economy, taking into account the balance between economic growth and environment preservation, is one of the main objectives in the sustainable chemistry research. This can be achieved if not only the precursors of these materials are environmentally friendly and renewable, ensuring continuity in the future, but also if the production process is also efficient, scalable and proceeds in a sustainable way. On the other hand, there is a global consensus that one of the most current critical aspects, in relation to the environment conservation, is the need to replace the current energy model based on fossil fuels with another that prioritize the use of renewable energy sources. However, those renewable sources are associated with the necessity of developing efficient energy storage devices, to modulate the energy supply by offsetting production and demand. The current alternatives for energy storage electrochemical devices face many disadvantages in terms of using critical components (e.g., Li, V, Cu, CO and some electrolytes), besides the urgent need to increase the performance of these devices in terms of energy density and durability.

With this general framework in mind, this work addresses the production of innovative carbon materials from non-critical precursors, and their optimization for further use as electrodes of sodium dual-ion batteries (Na-DIBs) as efficient and sustainable energy storage devices. These new batteries use carbon materials in both electrodes as well as non-critical sodium-based salts in the electrolyte. For this purpose, green precursors were used for the synthesis of two different materials: (i) polymers with controlled pore structure in the range of meso-macroporosity, obtained by the sol-gel methodology; and (ii) carbon foams, with very high open porosity. For the carbon gels, lignin-derived products were used as precursors and the sol-gel process is performed with microwave heating to reduce the process time considerably. On the other hand, carbon foams were synthesized, using sustainable and renewable sucrose as carbon precursor, either taking advantage of the gaseous reaction products released during caramelization or adding an iron nitrate, as foaming agents. The possibility to combine both materials to produce hybrid carbon foam/gel was also evaluated.

Carbon materials were employed as both anode and cathode in the Na-DIBs. Coin cells were assembled using a micro-fibre glass disc WHATMAN® GF/A as separator and NaPF6 1.2M (EC:EMC 1:1) as electrolyte. Cyclic voltammetry and galvanostatic charge/discharge tests were carried out to evaluate the battery performance in

terms of capacity, capacity retention and useful life. The influence of the chemical and porous properties of the different carbon materials considered on battery performance was studied to determine their feasibility for this specific application.

Acknowledgements: This work was funded by Science, Technology and Innovation Plan 2018-2022 of the Principado de Asturias and the European Regional Development Fund (FEDER) REF: AYUD/2021/5092.

FIGURES

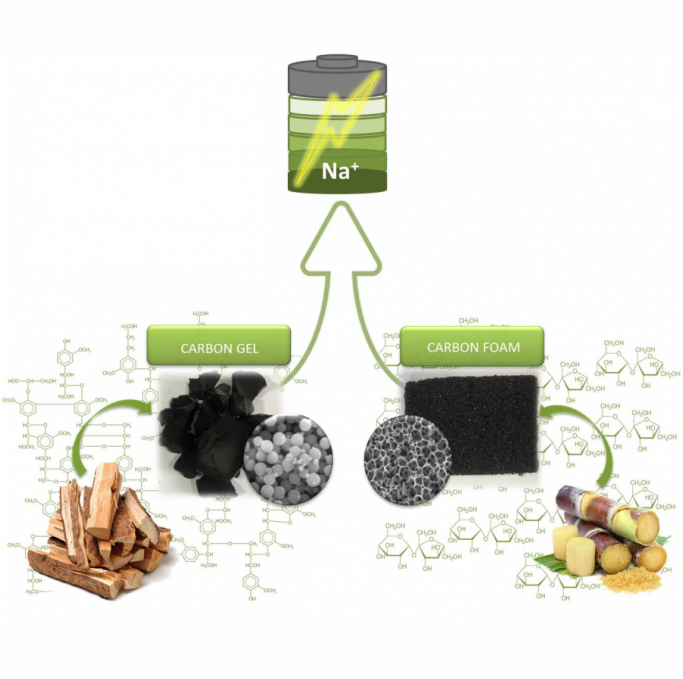

FIGURE 1
Graphical Abstract
Scheme of the process for obtaining sodium dual-ion battery electrodes from sustainable precursors

FIGURE 2

KEYWORDS
polymers | green chemistry | electrochemical energy storage | biomass conversion

BIBLIOGRAPHY