Hard carbons as anode for sodium-ion batteries: influence of material properties on electrochemical performances

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ABSTRACT

With the growing mondial demand for portable electronic devices and electric vehicles, it is needed to develop a clean and sustainable technology for energy storage. For that purpose, Na-ion batteries (NIB) are extensively studied by the scientific community because of the availability of their resources and their high energy density. This technology should be able to reach the performances of the lithium-ion batteries, leader in this field, with the aim of creating an energetic mix.

One of the most efficient negative electrode material for NIB remains to date the hard carbon, because of its capacity to host sodium ions better than graphite, with great performances (capacity, cycling behavior). Numerous precursors such as carbohydrates, polymeric resins or biomass can be chosen then pyrolyzed at high temperature (1000 to 2000°C) to obtain efficient hard carbons, sometimes to the detriment of the understanding of the sodiation mechanisms, still under debate in the literature.[1]

The aim of this study is to show the influence of the applied pressure during the pyrolysis of saccharose under 1000°C. This parameter is supposed to modify the porosity of the carbon material without changing its chemical composition, contrary to the influence of temperature. A set of hard carbon samples, elaborated under different pressures, has been analyzed by various and complementary multi-scale characterization techniques (XRD, electronic microscopy, Raman spectroscopy, SAXS, adsorption volummetry, He pycnometry…) to obtain a full overview of their properties.

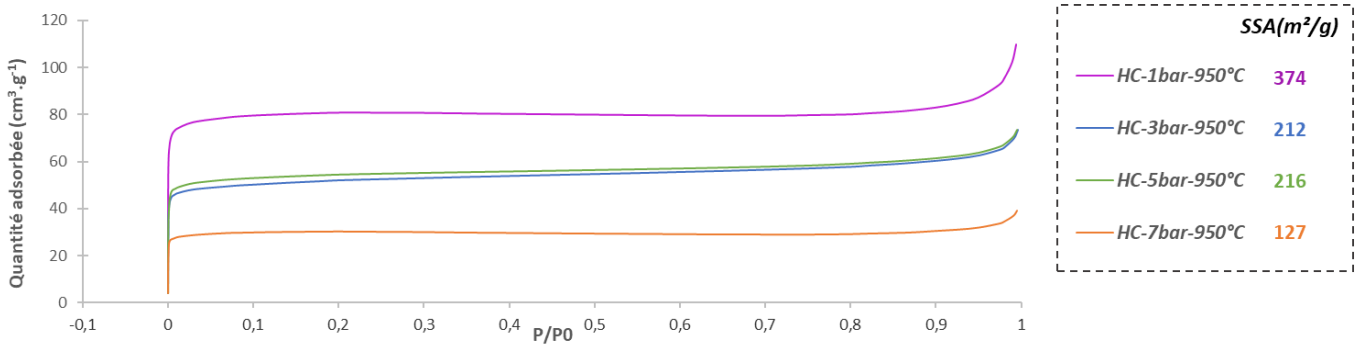

Figure 1: N_2 adsorption isotherms at 77K of hard carbons elaborated by pyrolysis under pressure

Those samples have been then integrated into coin cells versus metallic sodium for electrochemical tests, in order to probe the sodiation behavior upon cycling.

[1] F. Xie, Z. Xu, Z. Guo, M.-M. Titirici, *Prog. Energy* **2020**, *2* (4), 042002.