

Optimisation of the post-treatment of carbon-carbon composites for sodium-ion batteries

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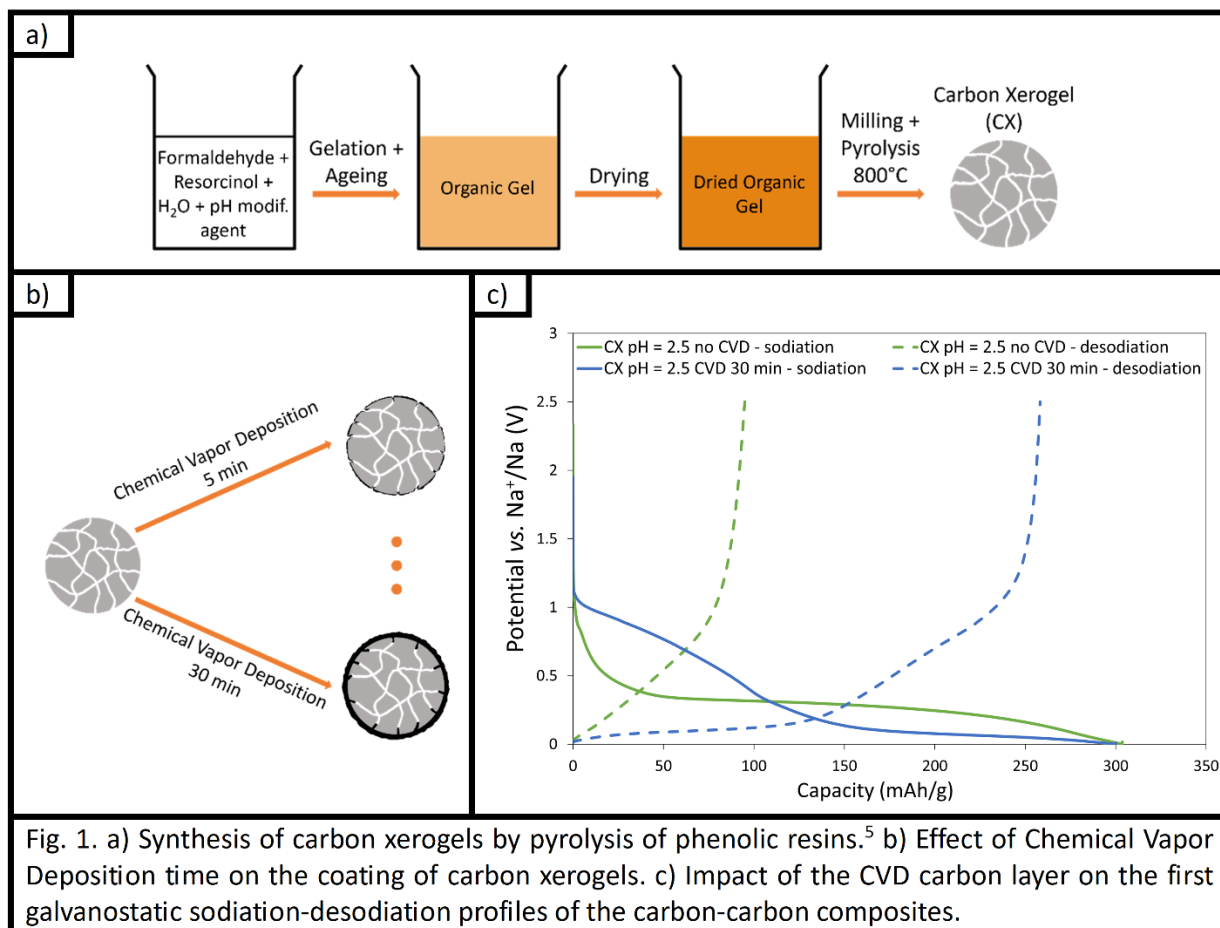
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The current environmental and energetic situation calls for an increased use and storage of renewable energies, which could be handled by rechargeable batteries. The head of the battery market is nowadays occupied by lithium-ion batteries, thanks to their high energy density and long cycle life.¹ Several of their basic components are however scarce and unevenly distributed, and their future unavailability is likely to limit their development. The switch to sodium-ion technology could partially solve this problem.²

Numerous research about positive electrode materials and electrolytes of sodium-ion batteries have been conducted recently³ but the negative electrode remains a delicate subject. The use of graphite, the classical negative electrode material of lithium-ion batteries, is not possible because sodium ions intercalate poorly within its structure³, which shows the necessity to investigate other materials. Within carbonaceous materials, hard carbons (i.e. non-graphitizable) synthesized by pyrolysis of organic precursors are promising: electrochemical capacities over 300 mAh/g have been reported.² However, these carbons have disadvantages such as their low densities and a significant irreversibility at first cycle, due to their high specific surface areas causing important electrolyte degradation and solid electrolyte interface (SEI) formation.⁴

In this work, which follows a first study⁵, carbon xerogels (i.e. micro-mesoporous hard carbons with a controllable pore texture⁶) were synthesized by pyrolysis of phenolic resins. A secondary carbon layer, which limits SEI formation by masking the micropores⁶, was then deposited using Chemical Vapor Deposition (CVD). Different thicknesses of secondary carbon layers were obtained by modifying the CVD process duration. To determine the impact of the pore texture and the thickness of the secondary carbon layer on the electrochemical performances, the synthesized carbon-carbon composites were thoroughly characterized by physicochemical techniques. Electrodes were produced using an aqueous-based process⁷ and were subjected to electrochemical characterizations. It is clearly shown that the CVD carbon layer improves the Initial Coulombic Efficiency by changing the carbon-electrolyte interface. The final goal is to establish clear relationships between the carbon-carbon composite material and the electrochemical performance.



References

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