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Comparative study of kapok-based self supported composites with TiO₂ or SiO₂ usable in Li-ion batteries

Julia Wagner^{*1,2}, Katia Guérin^{2,1}, Sandrine Berthon-Fabry¹

¹ MINES Paris, PSL University, PERSEE, CS 10207 rue Claude Daunesse 06904 Sophia Antipolis Cedex, France²

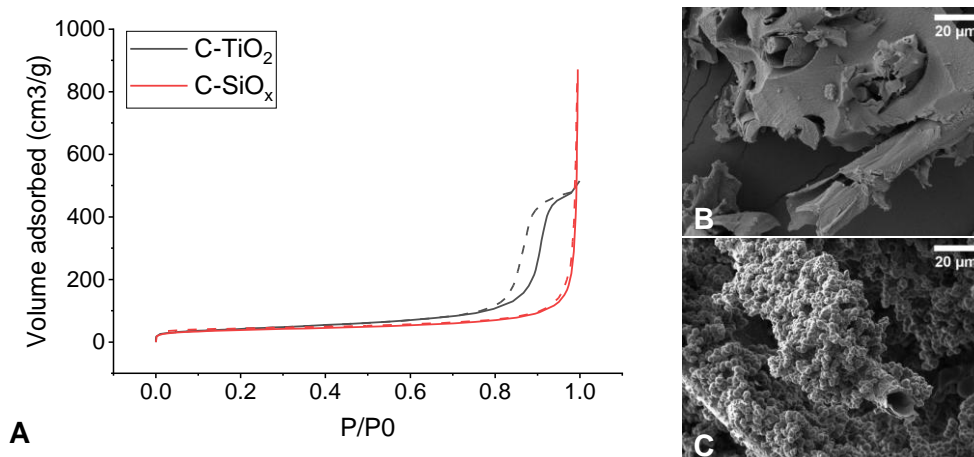
Clermont Université, ICCF, F-63000 Clermont-Ferrand, France

(*) julia.wagner@minesparis.psl.eu

Biobased and recycled materials are becoming more commonly used to create anodes for lithium-ion batteries. [1], [2], [3] Carbon-based materials can be obtained by pyrolyzing organic materials while keeping their initial shape. [4] In this work, we synthesized self-supported carbon-metal oxide composites using pyrolyzed kapok fibers. We chose two well known anode materials: TiO₂ processing through insertion and SiO₂ processing through conversion-alloying process. The main idea is to compare the efficiency and durability of self-supported anodes upon electrochemical mechanisms.

The TiO₂-based composite was synthesized by sol-gel. In order to reach the theoretical capacity of TiO₂ the physico-chemical properties of the composite were optimized. The lithium-ion-conducting anatase phase was obtained by modifying the acid used as a sol-gel catalyst and the pyrolysis temperature. The specific surface area and the material texture were varied by testing two drying processes (evaporative and CO₂ supercritical drying) and different thermal treatments. Finally, the optimal synthesis method was determined by galvanostatic cycling of the anodes.

The SiO₂-based composite was obtained from the pyrolysis of a silica-resorcinol-formaldehyde gel. Following the same methodology as TiO₂, different synthesis parameters were optimized. Specifically, in order to increase durability of the anode the effects of silica content, specific surface area and morphology were tuned by adjusting reagent and catalyst quantities. Finally, the optimal synthesis conditions were determined by galvanostatic cycling.



A: N₂ adsorption isotherms of C-TiO₂ and C-SiO₂ composites, B, C: SEM micrographs of C-TiO₂ (B) and C-SiO₂ (C) composites

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