BIOCHARS FROM VARIOUS BIOMASS TYPES AS ANODES FOR SODIUM-ION BATTERIES

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Until now, the applications targeted for biochars have mostly been focused in the field of energy, as combustion fuel, or of agronomy, as soil amendment. However, high-added value materials in the field of electrochemistry are now more and more mentioned as promising applications to investigate (Deng et al. 2016). At the moment, one major topic in electrochemistry is the development of alternative to lithium-ion battery in order to solve the issue of lithium supply. One of the most mature options is sodium-ion battery (Wang et al. 2016). In such battery, anode is generally made up of hard carbon, that has surface area below 10 $m^2.g^{-1}$ and subnanometric pores. However, hard carbon usually comes from fossil sources. It is therefore negative for process environmental balance, and is moreover quite expensive. Hence, the use of biomass residues as precursors of anode would be highly beneficial both in terms of cost and environmental impacts. Only very few studies have explored this option up to now (Jiang et al. 2016). They consisted in performance tests of batteries obtained from one or two biomass examples, neither specifically selected nor characterized in terms of composition.

The present study aims at filling in this gap through evaluating feasibility of using biochars produced from several representative biomass types as source of anodes for sodium-ion batteries and thus drawing the link between biomass properties and the resulting char performance. To achieve this goal, chars were obtained by slow pyrolysis of four different biomasses. These chars were then characterized in terms of structural and textural properties, prepared as anodes and finally tested during successive cycles to assess battery performance and correlate it with biomass composition.

Whatever biomass, the char could be successfully used in cells. Biomass appears therefore as a promising feedstock for this application. However, clear differences could be observed between biomasses in terms of Coulombic efficiency and to some extent of cycle stability. Hence resinous wood appears to be the most suitable precursor (see results of cycling stability test in Figure 1), while wheat straw would be the least one, probably because of a too high surface area. While no simple link could be established between results and biomass properties, hypotheses were suggested about the influence of lignin and hemicelluloses composition as well as about the absence of influence of inorganic elements.

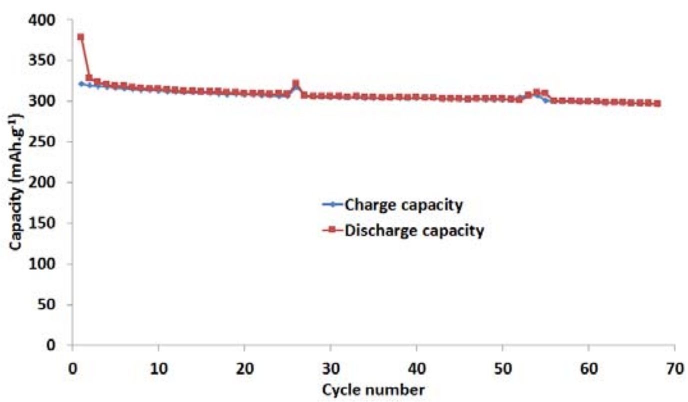

Figure 1. Cycling stability for battery based on pine char

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