Valorisation de liqueur noire résidu de l'industrie des pâtes à papier en matériaux carbonés pour le stockage d'énergie

Valorization of black liquor waste from paper and pulp industry into carbon materials for energy storage

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Contexte

Black liquor is an abundant by-product of the paper industry that results from digestion of wood chip in alkaline pulping processes. It contains a large fraction of alkali lignin that represents a renewable carbon feedstock. However, either disposed or used as fuel for energy recovery, it is an important source of emissions of toxics and pollutants, which control requires secondary treatments with high cost technologies that significantly impact the economy of the overall process. Valorization of black liquors into green added value products can in this context be envisaged as a more profitable route in the management strategies of waste and pollution generated by paper manufacturing units.

On another hand, light energy storage devices face a huge market expansion moved by the ever increasing use of connected objects together with intermittent renewable energy sources. Sustainable production of such devices implies the use of renewable material components available from large feedstock. Black liquors of the paper industry match these criteria, whilst recent literature reports exceptional electrochemical performances of carbon composite anodes in Li-ion batteries prepared from black liquor after just a single thermo-chemical treatment step, that are even far higher than pure graphene.

This study aims to valorize an abundant industrial bio-resourced waste causing pollution in an innovative added value product to be used in energy storage devices. By this way, the research contributes to answer several major societal challenges: circular economy, environmental protection and technological development for energy transition.

Objectifs

The anode material in the battery demands microporous carbon material having a pore size less than one nanometer, with a porous volume of greater than 0.5 cubic centimeters. This was achieved by applying hydrothermal and thermal reduction techniques in the literatures. In this study, the desired properties will be achieved by employing microwave treatment, a novelty method in the valorization of black liquor. Microwave is expected to faster the thermal treatment at a lower temperature, so reducing the energy costs of the manufacturing process. In addition, thanks to uniform heating within the core of the material, the properties of the final carbon product should also be better controlled. Steam and carbon-di-oxide will be employed as activating agents. The objective of this research will be to define the operating conditions of the synthesis process that optimize the functional properties of the carbon electrodes. The nanostructure and textural properties of the carbon samples will be so characterized from a variety of experimental methods (physisorption, XRD, Raman spectrometry, electron microscopy…). Mechanical properties and electrical performances also will be tested.

Compétences requises : Chemical engineering education.