ULiège - GREEnMat
Your Partner for Materials in Energy Storage

CONTACT INFORMATION

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EXPERTISE OVERVIEW

HEADLINE:

Synthesis (up to pilot scale) of anode/cathode materials + battery assembling/testing & recycling

POTENTIAL CONTRIBUTION:

GREEnMat - a chemistry research laboratory - is specialized in the **optimized synthesis and recycling of nano-/microsized powders** (oxides, hybrid, ...) as cathode or anode materials, the **development of formulations** (suspensions and/or slurries) for the **processing of layers (by spray or tape-casting)** to be **assembled into** batteries (from **coin to pouch cells**).

GREEnMat is the only Belgian university laboratory able to **produce and evaluate** inorganic materials for Na- and Li-ion batteries from laboratory to pilot scale (grams to kilograms) with its own equipment.
It is indeed equipped with several **pilot units** for the **green synthesis of powders**: two hydrothermal reactors (5.5 and 100 liters) and two spray-dryers (5 liters/h - aqueous or non-aqueous (ATEX-inert atmosphere) feed). GreenMat has also equipment for the **deposition of the electrode or electrolyte materials** (Spray and Doctor Blade).
GREEnMat aims at preparing (new) materials with well controlled morphology and at **reducing use of critical raw elements (using Fe, Mn, P, S, Si,** .....) by **green processes.**
Different synthesis conditions and electrode preparation parameters are tested to **maximize energy and power density and to improve the overall system cyclability.**

GREEnMat has also an extensive expertise in **material characterization** and is equipped for:
(i) the complete physico-chemical characterization of the designed materials (XRD, Mössbauer spectroscopy, scanning/transmission electron microscopes, TG/TDA, SEM, TEM, BET, Raman spectroscopy, etc.)
(ii) the cell assembly and **electrochemical characterization** of the materials in half-cell and full-cell configurations (**coin cell and pouch cells**).
GREEnMat has capabilities to **manufacture prototype cells** or **cell components with distinctive features.**

All obtained materials are thoroughly analyzed using electrochemical techniques (galvanostatic cycling, cyclic voltammetry and impedance spectroscopy). GREEnMat is also experienced in the study of the reaction mechanisms operating during the discharge/charge processes of electrode materials by ***operando*** **and** ***in situ*** **techniques** (XRD, impedance and Raman spectroscopies).

Today, the laboratory is currently involved in several national and European **research projects** related to the synthesis and the development of new materials for Alkali-ion batteries and also recycling of batteries.

Two projects were dedicated to **recycling** of **silicon wafers from solar panels** and to use **pure Si material as anode material for Li-ion batteries** which led to dispersed nanometric Si particles in carbon matrixes. Si/C electrode shows 100% of capacity retention (1200 mAh/g) after more than 1400 cycles at 1C, which led to the **patent** "**Silicon-Carbon Composite Anode Material**" (WO/2020/099589).
A new project is beginning on **the purification of the recycled Si** fractions from solar panels to be used as anode materials for rechargeable ion batteries.

Two projects are devoted to the **synthesis of new phosphate materials by solvo/hydrothermal reactions**. Another project is focusing on the **development of polyanionic electrodes for Na-ion batteries**.

Other projects led to a **patent** on the **design and manufacturing** of "**Flexible thin-films for battery electrodes**" (WO/2018/141659).
The working electrode was based on LTO prepared by spray drying method. The flexible electrode delivers a specific capacity of 175 mAh/g (100% of the theoretical capacity) and 145 mAh/g (85% of the theoretical capacity) at C/4 and 1C respectively.

Since 2019, GREEnMat has started working on **solid** polymer **electrolytes** on the cell assembly, and the electrochemical characterizations. Different tests were carried out to optimize the solid electrolyte formulation and thickness to achieve good electrochemical cycling at room temperature. Production capacity and specific technologies available at GREEnMat (spray-drying under inert atmosphere) could be used to produce at pilot scale new inorganic solid electrolytes for manufacturing all solid-state battery.

A new project just started on the **recycling of Li-ion batteries** in order to synthesize **NMC cathode materials from recycled raw materials**.

Since mid-2022, GREEnMat has started a project related to the **additive manufacturing of all solid-state batteries and is also involved in three European (including M-ERA.Net and Horizon Euorpe) projects relative to recycled Si for batteries.**

Thanks to its expertise and available infrastructure, GREEnMat is positioning as your partner for battery materials (anode, cathode or solid electrolyte) to support and accelerate your research projects in the field of energy storage and circular economy.

Download here our brochure where you can find an overview of our research topics and information about our pilot-scale equipment.

For more information about our energy storage research and publications **click here**.