

Electronic devices made of recycled fibers – Challenges and opportunities

Context

Several projects in the framework of circular economy are in progress at LGP2 in collaboration with LEPMI: French research program within ANR Funding (REVeBIO project) and European CircEl-Paper project (<https://circelpaper.eu/>). In both of them, the use of cellulosic substrate for printed electronics is a major advantage that allows to carry out recycling of the e-devices and valorization of the recovered fractions.

Electronics printed on flexible media are omnipresent in our connected world. Very often, electronics are printed on plastic, which makes its recycling difficult or even impossible. In 2019, 53.6 Mt of electronic and electrical waste were produced worldwide and only 17.4 % of this waste was properly collected and recycled (*The Global E-waste monitor 2020*, <https://ewastemonitor.info/gem-2020/>). From this electronic and electrical waste, printed circuits boards (PCBs) concentrate the majority of precious metals (Au, Ag, Pd, Cu, etc...). However, the epoxy resin-based support largely used makes the recycling and extraction of these metals difficult. Resin-based support can therefore be replaced by a paper support.

Previous studies have been conducted using virgin fibers for the elaboration of the support. In this internship, virgin fibers will be substituted by recycled fibers, produced at lab-scale. The general objectives of the internship are 1/ to reproduce several fiber recycling cycles at lab-scale while following the impact of the recycling on the fiber properties; and 2/ to produce e-devices on recycled fibers while assessing their functional performances and their recycling ability.

This work will be based on the CircEl-Paper and REVeBIO results, which have shown that it was possible to optimize conventional paper recycling processes in order to successfully separate silver inks from cellulosic fibers.

The student will work on the several topics:

- Reproducing paper recycling at lab-scale, using as starting raw material a commercial paper made of virgin fibers, and used for electronic printing. Lab-scale recycling will be mimic by the formation of oriented sheets followed by drying and then re-pulping. Several cycle of recycling will be performed and in parallel the fiber hornification phenomena will be quantified.
- Manufacturing of simple functional devices in order to test their characteristics on non-recycled papers and on papers manufactured after several cycles of recycling
- Assessing the recyclability of the functional devices by using the recycling chain already set up in the previous projects (pulping, cleaning)

Location and practical aspects

The student will work under the supervision of 2 senior researchers, N. REVERDY-BRUAS and N. MARLIN, experts respectively in printed electronics and recycling processes and also with a PhD student Arnel BRZOVIC. The research work will be performed at LGP2, Laboratory of Process Engineering for Biorefinery, Bio-based Materials and Functional Printing - UMR 5518 (Grenoble INP-UGA, France, <https://lgp2.grenoble-inp.fr/en>) with interactions with partners and especially with LEPMI laboratory (<https://lepmi.grenoble-inp.fr/>).

Internship will start in February 2025 for a duration of 5 to 6 months.

Applicant Qualifications

The candidate should be at master 2 level - or equivalent - and have a solid knowledge in process engineering and physico-chemical processes. Knowledge of lignocellulose chemistry and a previous experience in laboratory in this field will be appreciated. The candidate should have a strong aptitude for experimental work and be able to work independently.

How to apply?

Send your CV, a motivation letter, master transcript (marks) to Nadège REVERDY-BRUAS, nadege.reverdy-bruas@grenoble-inp.fr, Nathalie MARLIN, nathalie.marlin@grenoble-inp.fr and Arnel BRZOVIC – arnel.brzovic@grenoble-inp.fr – Deadline to apply: 30/11/2024