Challenges of recycled electronic devices on paper – Silver recovery for silver particles manufacturing

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 2022, 62 Billion kg of electronic and electrical waste were produced worldwide and only 22.3 % of this waste was properly collected and recycled (*The Global E-waste monitor 2024, https://ewastemonitor.info/the-global-e-waste-monitor-2024/*). 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 and recycled fibers for the elaboration of the support. Encouraging results were conducted to recover the high-added value materials such as silver. They also lead to the manufacturing of new silver particles suitable for ink formulation. In this internship, new paths for more sustainable methods will be investigated. The general objectives of the internship are 1/ to separate the fibres from the silver after one or several cycle(s) of recycling; and 2/ to develop new paths of silver treatments issued from the rejects for the manufacturing of recycled silver particles. This study could also focus on the analysis of the manufactured particles size in order to be suitable for ink formulation.
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 in order to produce two fractions: a cellulosic rich one and a silver rich one
- Treatment of the silver rich fraction in order to valorize the recovered metal
- Characterizing of the manufactured silver particles

Location and practical aspects

The student will work under the supervision of 3 senior researchers, N. REVERDY-BRUAS, N. MARLIN and L. SVECOVA, experts respectively in printed electronics, recycling processes and metal recovery 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) for the recycling part and at LEPMI, Laboratory of Electrochemistry and Physical-Chemistry of Materials and Interfaces (https://lepmi.grenoble-inp.fr/en) for the metal recovery.

Internship will start in February 2026 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 Lenka SVECOVA, lenka.svecova@grenoble-inp.fr – Deadline to apply: 10/12/2025