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Ph.D. thesis (2023-2026)
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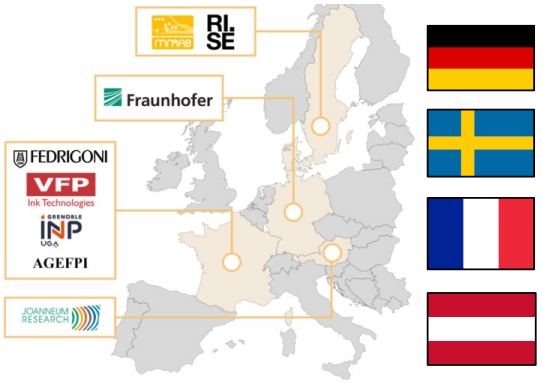
Recycling of multilayered electronic devices printed on cellulosic substrates

Etude de le recyclabilité de modèles complexes d'électronique imprimée sur papier par adaptation de lignes de recyclage papier existantes.

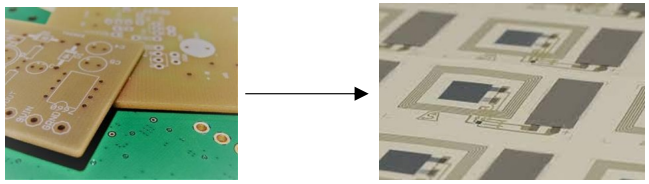
BioChip FunPrint

Context / Objectives

European Circel-paper project



Only **17.4 %** of the e-waste is documented to be collected and formally recycled worldwide.



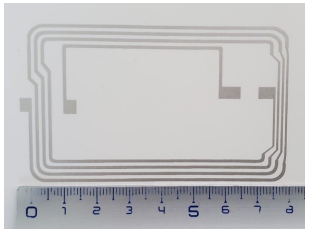
FR4 PCB → *Paper PCB*

- Challenges:

1) Recover the fiber fraction with minimum contaminants.
2) In a second fraction recover functional materials.

Methods

1. Paper printed electronics



Powercoat XD200
- Silver conductive Ink
- Coated paper
- 200 g/m^2

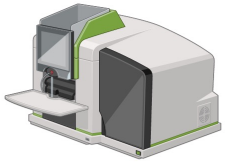
2. Conventional paper recycling line

Pulping → Screening → Centrifugal cleaning → Flotation

Units are optimized individually and tested sequentially as part of the process.

3. Atomic Absorption Spectroscopy (AAS)

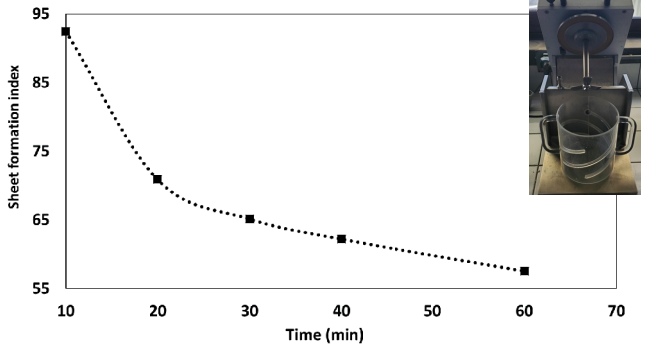
Objective: silver tracking



Ash + silver
↓ Leaching in Nitric acid
Solvated silver Ag^+

Results

1. Pulping optimization



The optimization involves monitoring the properties of handsheets as they vary with several parameters.

2. Silver Recovery

Centrifugal cleaning emerges as a highly promising unit operation for the separation of silver from fibers.

Ag= 100 % → inlet → Centrifugal cleaning → accepts → Ag= 2-3%
Centrifugal cleaning → rejects → Ag= 90 %

→90 % of the silver can be recovered from the pulp.