THE GREEN INK:
SaP NEWSLETTER
2ND ISSUE

SUSTAIN A PRINT

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Finding greener alternatives and combining recyclability and degradation into electronic designs

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1. Market Dynamics: An Overview

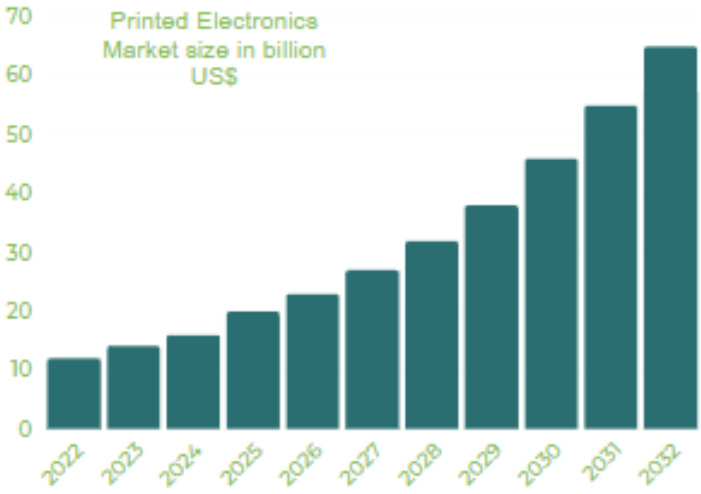
Market Analysis for Printed Electronics:

Printed Electronics Market expected to Boom, Growing up to $64.69 billion by 2032.

The Printed Electronics (PE) market was valued at 12$ billion in 2022 and is on track for explosive growth, with projections estimating it will reach $64.69 billion by 2032. This rapid expansion is driven by a remarkable Compound Annual Growth Rate (CAGR) of 18.4%.

Key factors behind this increase include the rising demand for printed electronics and their functional applications across multiple sectors. From OLED displays and RFID devices to the automotive industry, medical equipment, aerospace, photovoltaic devices, and construction, printed electronics are establishing into more and more industries.

Additionally, the printed electronics market has the potential to break into even more sectors as its technology continues to evolve. Increased R&D over the past few decades in the field of PE have led to industry´s growth, due to essential advancements and technical innovations.

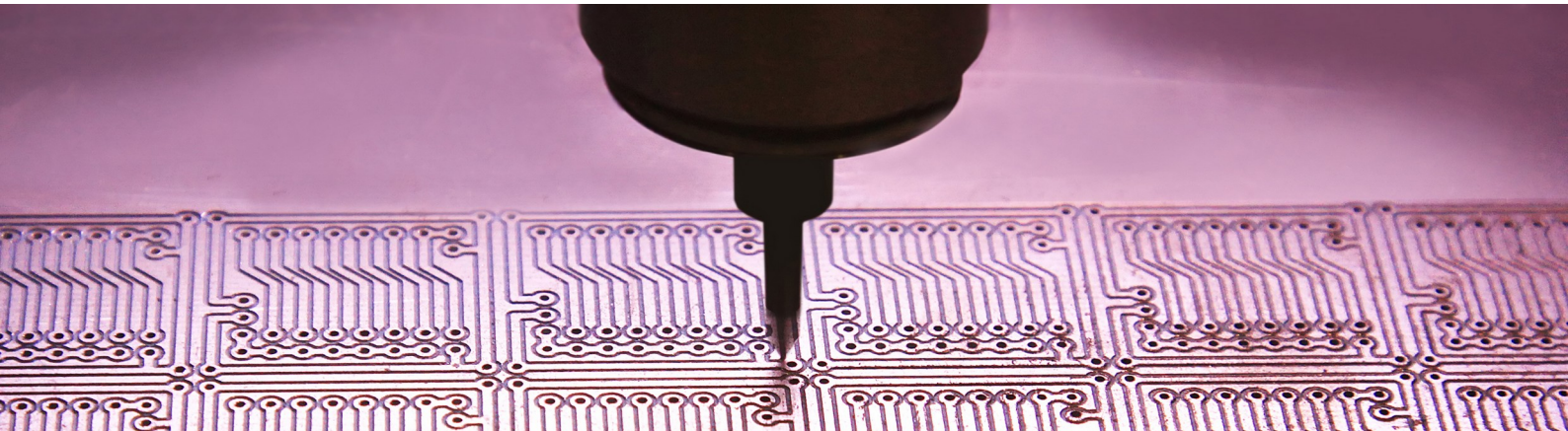


Market share of Printed Electronics until 2032 in billion USD$

Experts suggest that these developments will continue to drive the market's expansion, opening doors to new applications and reinforcing the importance of printed electronics in the global economy.

RELATED LITERATURE

[1] PRINTED ELECTRONICS MARKET 2023-2032, PRECEDENCE RESEARCH, NOVEMBER 2023



2. Check out our 1st video

During our 6M Consortium Meeting in Athens, Greece the SaP project recorded its first video, offering viewers a unique perspective on the project's journey and its significant contributions to sustainable printing technologies.

The video, produced by AXIA Innovation, features exclusive interviews with key partners, providing insights into their crucial roles in the SaP project. Christian Rein, the project coordinator from the Danish Technological Institute (DTI), discusses his role in overseeing project coordination and shares his expertise in sustainable printing technologies. Pablo Fanjul, from Metrohm DropSens explains their technical role and innovative solutions in sustainable printing. Camilla Andersen from Melsen Tech discusses practical implementation, offering insights into the real-world applications of these technologies.

Nikolaos Bikiaris, an expert in materials science and engineering from Aristotle University of Thessaloniki (AUTH), highlights the advancements achieved in sustainable printing, while Kasper Moth-Poulsen from Universitat Politècnica de Catalunya (UPC) shares their research contributions, shedding light on the project's technical aspects.

Scan the QR code or **CLICK HERE** to check out the video:





3. News and updates: Press releases & past events

SaP Project's Vision for Fully Recyclable Printed Keyboards Featured in Danish Newspaper

We are excited to inform you that our SaP (Sustain-a-Print) project has been featured Danish newspaper aktuel elektronik, where Camilla Andersen took the chance during Melsen Tech's anniversary celebration to speak about the project.

During the Interview Camilla Andersen mentioned that the SaP Project aims to create fully recyclable printed keyboards, a groundbreaking initiative supported by the European Union and involving six countries in a collaborative effort. The goal is to ensure that every component of these keyboards can be recycled, fundamentally transforming the industry. The project focuses on reusing silver conductive traces to create new ones, thus advancing sustainability in electronic components.

Through partnerships with industry and research institutions, the SaP project is testing innovative technologies, including inkjet printing, and exploring the use of colors to enhance the aesthetic appeal of the keyboards. This collaborative approach allows the team to leverage the expertise of the Technological Institute and other key partners to push the boundaries of sustainable printing technologies.



Check out all our Press releases at our Website:

Our Coordinator Christian Rein from DTI, Highlights Sustainable Electronics in Ingeniøren´s Interview



Christian Rein, the coordinator of the SaP (Sustain a Print) project at the Danish Technological Institute, was interviewed by Ingeniøren, Denmark's leading technology and science publication, which has been in circulation for over 130 years. During the interview on February 8, Christian Rein outlined SaP's mission to create sustainable materials for electronic components, focusing on making recycling easier and more effective.
Christian Rein discussed the challenges posed by traditional electronic devices, which contain components that are difficult to recycle and often consist of valuable materials like silver and gold. SaP aims to change this by developing electronic parts that can be removed and recycled, reducing the amount of electronic waste and maximizing the recovery of valuable materials.

A key part of SaP's approach involves replacing silver with copper in electronic components, using a specialized copper ink and nanotechnology. This transition not only makes recycling more efficient but also reduces the environmental impact associated with traditional material extraction. The goal is to establish a circular system where outdated electronics can be broken down to create new components.

Christian Rein emphasized that the project's vision is to improve every stage of the recycling process, from materials and ink to electronics and recycling methods, to promote a circular economy in electronics. While discussing the project's ambitions, Rein noted that it's still early days, acknowledging the technical challenges that could arise when scaling lab successes to industrial levels. Despite these hurdles, he expressed hope that the project could contribute to bringing more electronics production back to Europe, benefiting the environment, human health, and reducing dependence on other countries.

Check out all our Press releases at our Website:

SaP Consortium Holds Successful 12M Meeting in Valencia



The Sustain a Print (SaP) consortium successfully concluded its 12-month general assembly meeting at ITENE's headquarters in Valencia on October 18-19, 2023. Representatives from all partner organizations attended, presenting their latest work.

One of the highlights of the meeting was an eco-design workshop hosted by LOMARTOV SL. The workshop had a theoretical component, where participants learned about the principles of ecodesign, followed by a collaborative brainstorming session. This session allowed each partner to share ideas and feedback on how eco-design could further the goals of the SaP project.

In addition, the partners toured ITENE's facilities and attended a dinner, providing a more informal setting to discuss the project's progress and future steps. These activities fostered collaboration and strengthened the consortium's commitment to achieving its sustainability goals.





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LOPEC 2024 in Munich



SaP took center stage at LOPEC 2024 in Munich, demonstrating its innovative approach to sustainable printed electronics. The collaborative efforts of the present SAP consortium partners Danish Technological Institute, Creative Nano, AXIA Innovation and Melsen Tech, were well received by attendees and industry experts.

AXIA Innovation distributed informative brochures that detailed SAP's initiatives, emphasizing the project's commitment to reducing the environmental impact of printed electronics. During the poster session, SaP unveiled its initial results, sparking vibrant discussions among industry leaders, researchers, and other stakeholders

This engagement reflects SaP's dedication to advancing sustainability and innovation in the printed electronics sector. By combining cutting-edge research with robust collaborative partnerships, SAP is helping to shape a greener and more sustainable future.

With this successful appearance at LOPEC 2024, SaP continues to establish its presence in the industry, signaling a promising direction for sustainable technology. The event provided an excellent platform for the team to share its vision and progress, inviting further collaboration and exploration in the field of printed electronics.



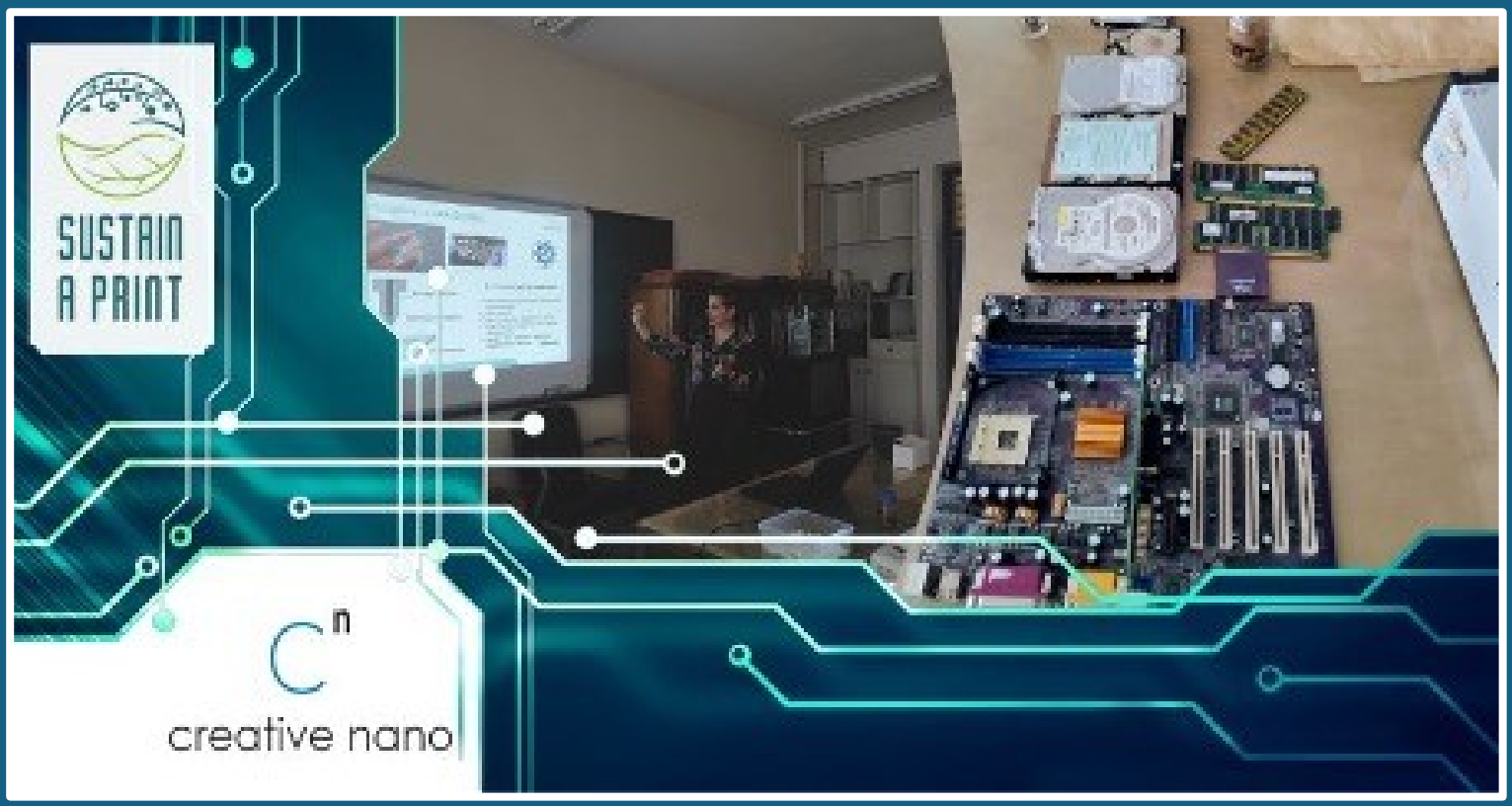
Sustain a Print (SAP)
Shines at Aristotle University of Thessaloniki's 2nd Open Day

During the 2nd Open Day of the Aristotle University of Thessaloniki (AUTH), SaP was showcased at an informative stand and displayed a poster at the event, drawing interest from academic community members, and visitors. The AUTH group from SAP engaged with attendees, providing insights into the research being conducted and connecting with potential new researchers interested in the project's work. SaP not only increased its visibility within the academic community but also fostered valuable connections with up-and-coming researchers and university members.





Sustain a Print Brings Eco-Friendly Printed Electronics to 2nd Primary School in Nikaia, Athens

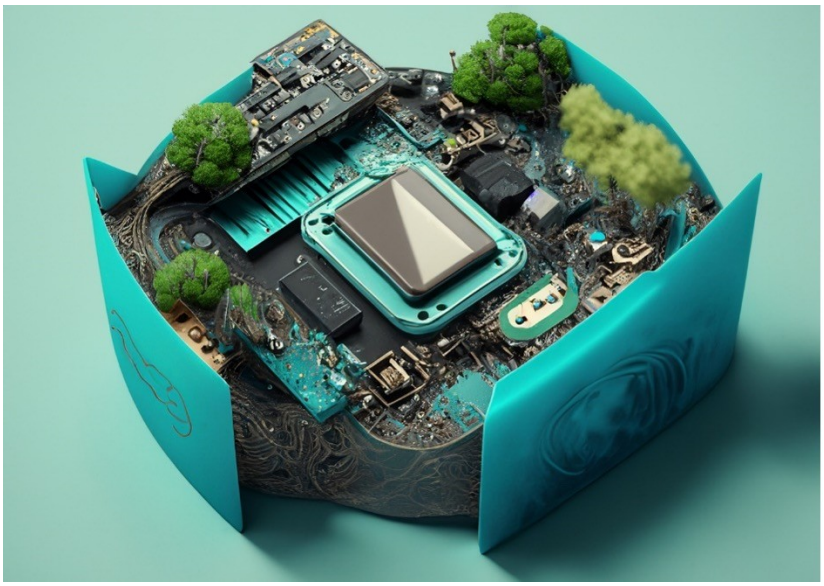


Our Partner Creative Nano (Cnano) is bringing the future of eco-friendly technology to the 2nd Primary School in Nikaia, Athens, Greece. This initiative showcases innovative developments in sustainable printed electronics, offering a glimpse into a greener technological future.

Within the Project Creative Nano explores the use of lignin-based hybrids in ink formulations, a breakthrough approach that promises to revolutionize printed electronics. Cnano plays a key role in this venture, demonstrating advanced polymers designed with sustainability as a core principle. These innovative materials help minimize environmental impact while paving the way for new possibilities in eco-friendly technology.

Cnano aimed to inspire the next generation with practical examples of how technology can be both cutting-edge and environmentally conscious. By engaging with the students at the 2nd Primary School, the project encourages curiosity and fosters a greater understanding of sustainable practices in the tech industry.

4. 18-Month update: Partner progress and achievements





TEKNOLOGISK INSTITUT

DTI has collaborated with other EU-funded projects at OE-A and EPoSS workshop on Functional Electronics for Green and Circular Economy (2022) resulting in a presentation and social media post.

Click here to find out more about the Workshop

Presented "Upscaled production and testing of conductive inks: The case for copper nanoparticle inks" at LOPEC (2023).

DTI Presented SaP at "HI Tech & Industry Scandinavia" and "IDA TECHNOMANIA 2023".

Moreover, DTI Presented SaP at Lopec (2024).

creative nano

Creative Nano developed MWCNTs-Lignin hybrids with/or functionalized MWCNTs (e.g., nickel-coated MWCNTs and carboxylate MWCNTs). The resulting hybrids presented low HDD, ranging between 370 to 600 nm, depending on the type of MWCNTs. Additionally, all the produced hybrids demonstrated σDC values higher than 10^-4 S/cm, indicating significant electrical conductivity. These hybrids have been sent to CPI for testing in conductive ink formulations.

18-Month update: Partner progress and achievements

In an era where environmental consciousness is increasingly at the forefront of global concerns, integrating eco-design principles into product development processes has emerged as a pivotal strategy for fostering environmental sustainability. Eco-design, as defined by the European Commission in 2009, entails the incorporation of environmental considerations throughout all stages of a product's lifecycle, from conception to disposal. This holistic approach not only aims at reducing environmental impacts but also encompasses economic and social dimensions.



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18-Month update: Partner progress and achievements

LOMARTOV
[Applied Innovation Engineering]







Research indicates that a significant portion, approximately 80%, of a product's environmental footprint is determined during the early stages of design (Kunnari et al., 2009). Once products materialize and enter the market, opportunities for substantial environmental improvements diminish. Thus, the value of embedding eco-design principles into product development processes becomes evident. This integration may necessitate re-evaluation or rebalancing of certain parameters to optimize environmental performance. For instance, sacrificing some aesthetic appeal in favour of enhanced durability can significantly reduce a product's environmental footprint.

Improved environmental performance often translates into economic savings and societal benefits. Eco-designed solutions aspire to be innovative, functional, cost-effective, and commercially successful.
Now, the European Commission is exploring the expansion of eco-design regulations to enhance the sustainability and circularity of other product categories (European Commission, 2019). This includes electronics, exemplified by projects like SUSTAIN-A-PRINT, aimed at integrating eco-design methodologies to improve environmental performance.

In the project, under the Task 7.3, LOMARTOV coordinated a project multidisciplinary team to propose, evaluate, and select eco-design strategies and actions for environmental improvement of target products. Through a series of work sessions, the team identified driving factors, assessed environmental hotspots, brainstormed potential strategies, and evaluated their viability using a Multi-Criteria Decision Analysis (MCDA) matrix.
Six eco-design actions were finally selected by the team for their implementation in the SUSTAIN-A-PRINT prototypes. Though the specifics remain confidential, these actions focus on reducing raw materials usage, integrating renewable energy sources, enhancing recyclability, and utilizing waste-derived materials.

This collaborative effort involved representatives from various companies and organizations, demonstrating a collective commitment to sustainable innovation. By leveraging eco-design principles, these initiatives not only aim to mitigate environmental impacts but also strive to cultivate a culture of environmental responsibility and innovation in product design and development.

18-Month update: Partner progress and achievements

ARISTOTLE UNIVERSITY OF THESSALONIKI

During the first 18 months, AUTH made significant progress regarding the task 2.3 of WP2 - Sustainable material development and task 5.3 of WP5 - Separation & recycling.

Based on Task 2.3 AUTH developed novel high molecular weight poly(lactic acid)-b-poly(ethylene azelate) (PLA-b-PEAz) copolyesters with high melting temperatures and concurrently tuning the mechanical performance of PLA, with elongation over 100% and high values of Young's modulus, during the tensile measurements, making the copolyesters strong, tough, and flexible substrates for printed electronics (PE). Furthermore, AUTH developed several PLA films via cast film extrusion to optimize the performance of the substrates for PE. All film samples required annealing tests for the best possible outcomes.

These experiments increased the mechanical performance, heat resistance, decreased shrinkage and curling effects subsequent to the application of high curing temperatures. The annealing experiments of the films took place inside a metal frame and via the imitation of biaxial stretching DTI was able to effectively print inks on top of the substrates. Based on the task 5.3 AUTH successfully investigated the recycling ability of poly(lactic acid) (PLA) and PLA-based copolyesters by the implementation of microwave irradiation through alkaline hydrolysis with 100% of degradation rate at specific conditions. After the depolymerization reactions of the PLA-b-PEAz 80-20 copolyester, azelaic acid was received.

AXIA INNOVATION

AXIA is dedicated to driving the Sustain a Print (SaP) project through effective communication, dissemination, and business planning. The project's website and social media accounts acts as a central hub for sharing information, project results, and updates.

The communication strategy includes creating dissemination materials such as flyers, posters, and videos, which are accessible on the website, alongside press releases, blog articles, and social media posts to reach a wider audience. AXIA's dissemination plan outlines key messages, target audiences, and promotional activities.

AXIA focuses on business planning and market analysis to identify opportunities. The individual business plan includes a CANVAS Business Model, SWOT, and PESTEL analyses. These were created for the project and the industrial partners from the consortium.

Intellectual property management is a critical aspect, were detailed ownership, protection, and confidentiality of the Key Exploitable Results (KER´s) are defined within the project.

18-Month Update: Partner Progress and Achievements

ITENE

Definition of Safe and Sustainability by Design (SSbD) Criteria.

Definition of a Score system to classify materials and processes depending on the SSbD criteria.

Toxicity and ecotoxicity assessment of the different raw materials and materials produced in the framework of the project.

Definition of SSbD strategies for specific materials to reduce their potential toxicity without comprising their function.

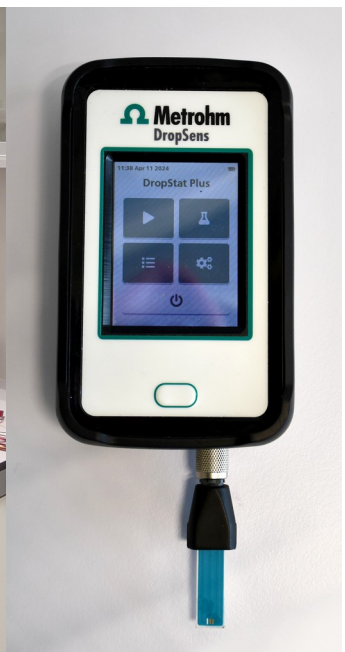
Metrohm DropSens

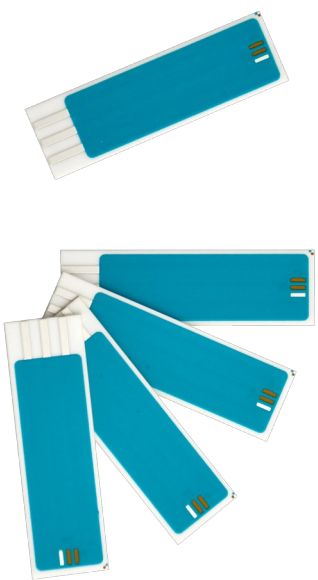
Metrohm DropSens designed the Biosensor design and defined the properties of substrate and inks.
Electrodes with the new design have been screen-printed but with conventional inks and methods.

Electrochemical characterization of the new design have been performed.

A glucose sensor have been developed using these electrodes.







SUSTAIN A PRINT

18-Month update: Partner progress and achievements

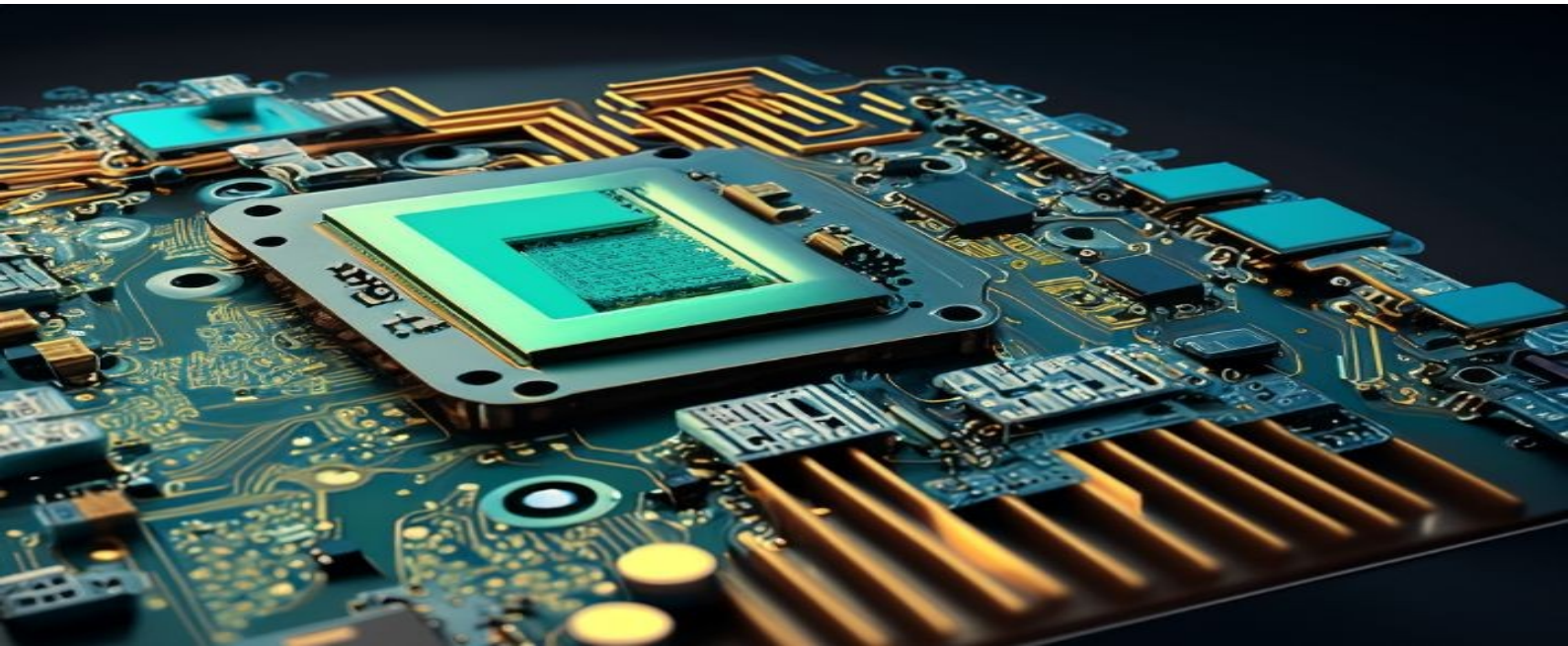
UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

In WP 5.2, we are working on the recycling of metals into metal precursors. The leaching of metals from waste printed electronics (PE) depends upon various process parameters such as leaching agent concentration, oxidizing agent concentration, temperature, time, stirring speed, and liquid-to-solid ratio. It is important to investigate the effect of all these process parameters to develop an efficient process.

Melsen Tech provided different types of waste PE for the experimental work. Presently, two types of waste PE i.e., silver (Ag) containing waste PE and copper (Cu) containing waste PE are being employed to investigate the leaching of metals. Initially, the pre-treatment of the waste PE was carried out. The samples containing Ag were shredded to the size of around 2 x 2cm² and then crushed using the grinder to reduce the size. The crushed samples were subsequently used for metal leaching experiments. The copper-containing samples were shredded to the size of 2 x 2cm² and further used for metal leaching. Currently, experimental work is in progress for the leaching of Ag and Cu using green solvent. We have been able to achieve the 90% Ag and 100% Cu leaching. The process parameters will be finalized after investigating the effect of all process parameters on the leaching of Ag and Cu.

melsen tech®

URS have been finished and handed in by Melsen Tech. Tests have been performed with commercially available copper. Sintering equipment have been purchased. Moreover, we participated at LOPEC twice.



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SUSTAINABLE MATERIALS AND PROCESS FOR GREEN PRINTED ELECTRONICS



#SUSTAINAPRINT

SAP PARTNERS

TEKNOLOGISK INSTITUT

creative nano

LOMARTOV

ARISTOTLE UNIVERSITY OF THESSALONIKI

AXIA INNOVATION

CENTRO TECNOLÓGICO ITENE

Metrohm DropSens

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