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Printed Future of Electronics

discover the objectives of the **FEMA** project

PRINTED FUTURE OF ELECTRONICS

Project launch "Pilot production line for printed electronics for the Internet of Things and wearable electronics"

1. What is printed electronics?

Printed electronics is one of the most promising technologies being developed at the intersection of materials science, electronics and modern manufacturing techniques. Unlike traditional electronics, which rely on rigid printed circuit boards (PCBs) and the assembly of numerous components, printed electronics are created by applying special conductive inks and pastes directly onto flexible substrates, such as polymer films, paper or fabrics.

This process is similar to printing newspapers or packaging, but instead of ordinary inks, materials with specific electrical properties are used. This makes it possible to create conductive tracks, sensors, antennas, electrodes or even more complex electronic circuits. Such solutions are lightweight, thin, flexible and can be produced in large quantities at relatively low cost.

Photo: examples of printed electronics (sensor array on film, healthcare patch, sensing insole

2. Why is FEMA project important?

The potential applications of printed electronics are extremely broad. This technology can be used in smart packaging for food quality monitoring, disposable medical biosensors, environmental sensors, RFID identification systems, and wearable electronics integrated into clothing. In the future, such solutions may become an important part of the growing Internet of Things (IoT), where everyday objects communicate with each other and provide information about their condition and surrounding environment.

Despite its enormous potential, many printed electronics technologies remain at the laboratory demonstrator or pilot-stage level. One of the greatest challenges is bridging the gap between promising research results and reliable, cost-effective industrial manufacturing. How can this barrier be overcome and the implementation of new technologies accelerated? This is one of the key questions addressed by the project.

3. A unique pilot production line is being established

One of the greatest challenges in the development of printed electronics is transferring promising laboratory results to industrial production. Processes that work well when manufacturing individual prototypes often require significant optimization before they can be scaled up for large-scale production. At this stage, many innovative ideas encounter technical barriers that delay or even prevent their commercialization.

This project addresses this challenge by establishing a unique pilot production line for printed electronics. The facility will be a modular research platform that replicates the key stages of industrial manufacturing while remaining flexible enough for research and development activities. It will enable researchers and industrial partners to test new materials, develop manufacturing processes, and validate innovative devices under conditions that closely resemble real production environments.

The new infrastructure will significantly shorten the path from research to market. It will support the development of manufacturing protocols, quality assessment of printed structures, and the optimization of production processes, helping to reduce the costs and risks associated with technology transfer. As a result, companies will be able to bring innovative printed electronics products to market more quickly and reliably. At the same time, Warsaw University of Technology will become one of the few research institutions in Europe offering such a comprehensive pilot-scale facility for printed electronics research and industrial implementation.

4. Electronics for the Internet of Things (IoT)

The Internet of Things (IoT) is a network of devices equipped with sensors that collect data about their surroundings and transmit it to other devices or analytical systems. Such solutions are increasingly used in industry, logistics, environmental monitoring, and healthcare. Printed electronics can play a key role in this field by enabling the production of lightweight, flexible, and low-cost sensors that can be integrated into everyday objects.

Printed sensors can monitor temperature, humidity, pressure, material deformation, and the presence of selected chemical substances. As a result, they can be used in smart packaging that monitors food quality, environmental monitoring systems, and solutions supporting the maintenance of technical infrastructure. The development of these technologies makes data collection simpler, more affordable, and more widely accessible, paving the way for new Internet of Things applications across many sectors of the economy.

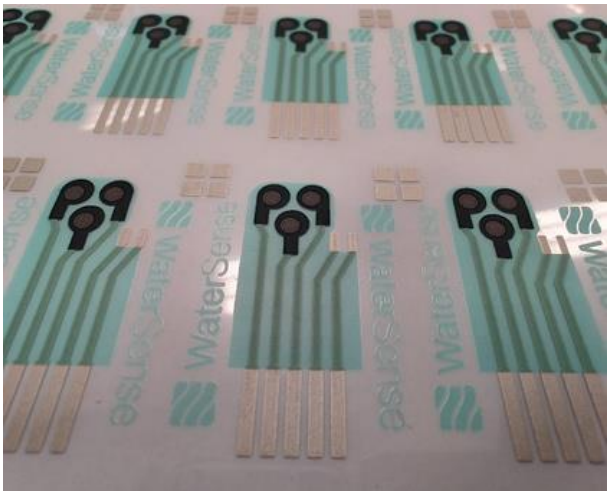
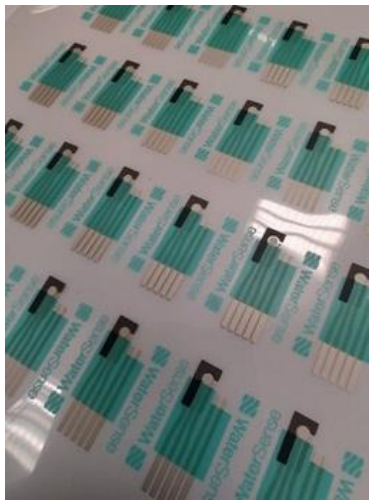



Photo: sensor for environmental monitoring

5. Smart textiles and wearable electronics

One of the fastest-growing areas of printed electronics is smart textiles and wearable devices. By printing functional layers directly onto fabrics or integrating them with conductive fibers, textiles can be given entirely new functionalities. Clothing is no longer limited to providing protection or aesthetic appeal – it can become an active platform for monitoring the wearer or the surrounding environment.

Electronics integrated into textiles can be used to monitor vital signs such as heart rate, respiratory rate, and physical activity. These technologies have significant potential in sports, telemedicine, rehabilitation, and elderly care. In the future, smart garments may enable continuous and non-invasive health monitoring, improving user comfort while supporting next-generation healthcare systems.

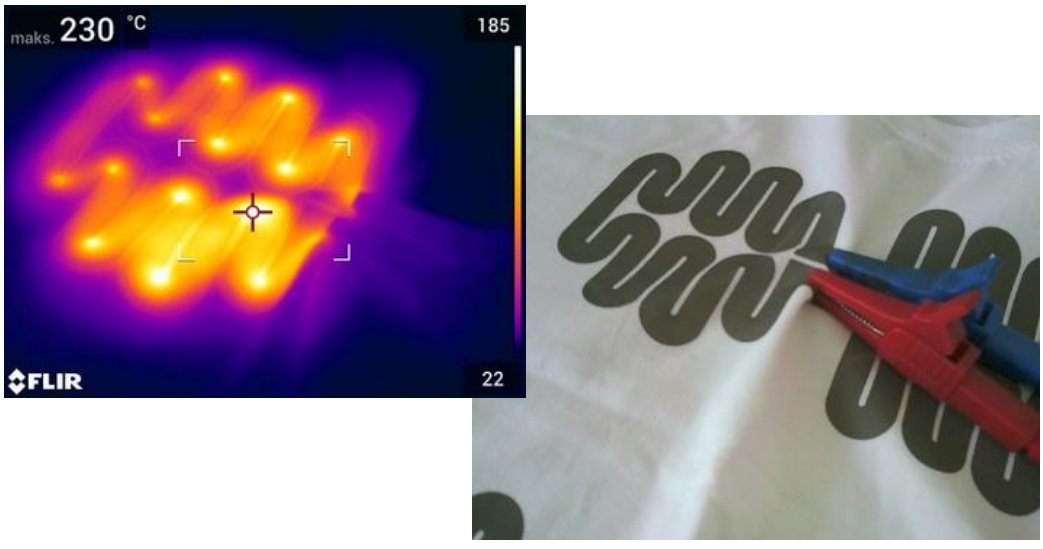
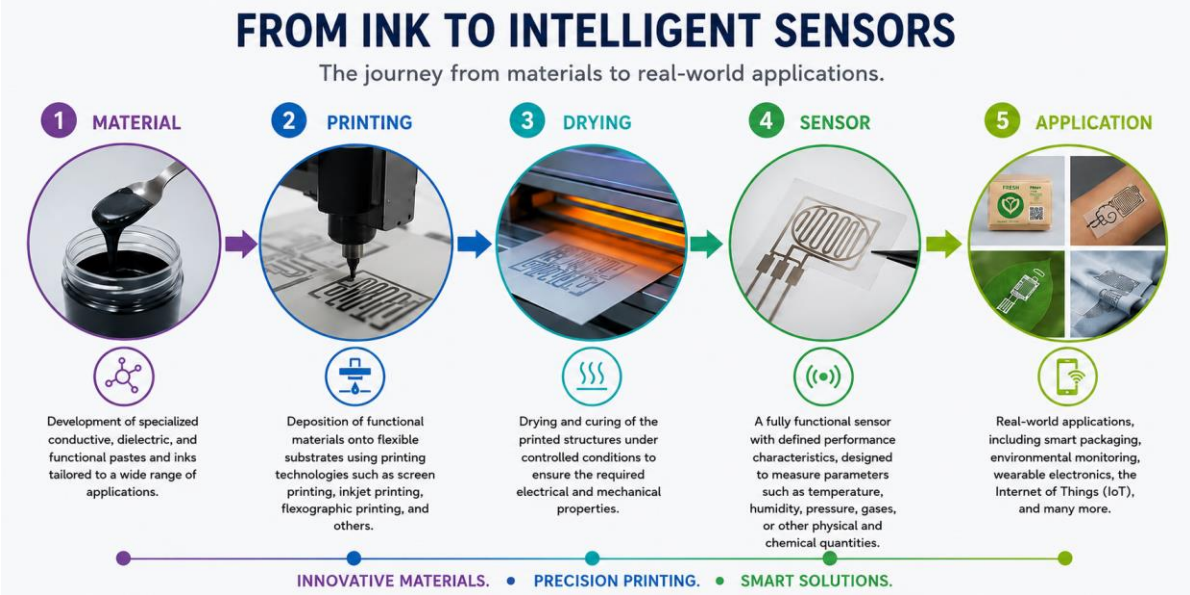


Photo: printed textile heaters

6. Materials for electronics of the future

The development of printed electronics would not be possible without advanced functional materials. Their properties determine whether printed conductive tracks efficiently carry electrical current, whether sensors provide sufficient sensitivity, and whether the final device remains durable during operation. Developing such materials requires expertise in chemistry, materials science, nanotechnology, and process engineering.

For many years, the research team at the Warsaw University of Technology has been conducting research on materials for printed electronics, developing conductive pastes, sensing inks, and formulations designed for deposition on flexible substrates and textiles. The ongoing project will further expand these capabilities by enabling the testing and optimization of materials under conditions that closely resemble industrial manufacturing. This will support the development of next-generation pastes, inks, and functional materials tailored to specific applications, ranging from environmental and biomedical sensors to smart textiles and Internet of Things (IoT) devices.



7. Benefits for industry and the region

One of the main objectives of the project is to strengthen collaboration between academia and industry. The new infrastructure will enable companies to test and develop innovative solutions without incurring the high costs associated with launching production or modifying existing manufacturing lines. This will be particularly valuable for small and medium-sized enterprises and start-ups, which often have limited resources but possess innovative ideas and strong potential for developing new products.

The project will also contribute to strengthening the innovation potential of the Mazovia region. By establishing this unique research infrastructure, the region will gain a center dedicated to the development of advanced technologies in printed electronics, the Internet of Things (IoT), and smart textiles. Collaborative projects between researchers and industry partners will help accelerate the commercialization of new technologies, create high-value jobs, and enhance the competitiveness of the regional economy based on knowledge and innovation.

Project

Title: “Pilot production line for printed electronics for the Internet of Things and wearable electronics”

The project is co-funded by the European Regional Development Fund under Priority: I “European Funds for a more competitive and smarter Mazovia,” Measure 1.1 – "Research, Development and Innovation in Enterprises"

Project type: “R&D infrastructure of scientific units.”, within the European Funds for Mazovia 2021–2027 programme.

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- Funding from ERDF: up to 4,619,818.00 PLN
- Project duration: 1.04.2026-31.12.2027

As a result of the project, a pilot production line consisting of at least five technological modules will be established. The planned infrastructure will support a wide range of applications, with a particular focus on the Internet of Things (IoT) and wearable electronics.

Photo credits:
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