About Vanguard

The demo-case on Nano-Enabled Printed Electronics is part of the New Nano-Enabled Products pilot of the Vanguard Initiative, and is led by Dr. Christian Punckt, Associate Director of NanoMat, KIT, Germany.

The Vanguard Initiative is an association of more than 30 EU-regions stimulating Industrial Modernisation through a more effective deployment of new technologies. More in particular, the Initiative aims at providing industrial companies easier access to (networked) facilities for demonstration, to lower technology uncertainty and speed up market uptake of new technologies, more advanced industrial production and new value chains.

Read more at the Vanguard Website:
http://www.s3vanguardinitiative.eu/cooperations/vanguard-initiative-pilot-project-new-nano-enabled-products

VANGUARD INITIATIVE
New growth through smart specialisation

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Nano-Enabled Printed Electronics

**A demonstration case,
part of the Vanguard Initiative on
New Nano-enabled Products Pilot**

Scope & Organisation

The Nano-Enabled Printed Electronics demonstration case (part of the Vanguard Initiative on New Nano-enabled Products Pilot) wants to bring functional printing into industrial application and complete value chains with this additive, simple and fast technique.

Nanomaterials and nanotechnologies are key components in the field of Printed Electronics (PE), a cross sectional technology with the potential for strong growth. Potential application fields include intelligent sensors (automotive, medical technology, food monitoring and smart textiles), the Internet of Things (IoT), security applications, energy storage and energy harvesting. As an additive production method, PE can save resources and energy and can thus reduce production costs and the ecological footprint of products.

The printing of functional materials such as conductors, semiconductors, or dielectrics and insulators has been further developed in the past years, and today devices such as transistors, solar cells and batteries can be produced via printing. That being said, PE research and development is to a large extent still carried out in Universities and research institutions.

The challenge tackled by the Nano-Enabled Printed Electronics demonstration case is the transfer of such technologies from the lab to the market. Therefore, we offer an integrated support for technical as well as answers to strategic questions. We accompany a project from the idea until the market launch of the product in order to support its access to markets.

The Nano-Enabled Printed Electronics demonstration case actively approaches potential project partners and works to increase its network of partners from both industry and research organizations. We aim to complete value chains and bring partners together who cover all aspects of the technology – from the materials supplier to the end user.

Application areas

The following application areas are clear and centrally applicable markets of interest:

Smart tags and sensors

Against the backdrop of IoT, customers and companies want to receive and provide information anywhere and at any time. Thus, products are nowadays equipped with sensors for monitoring e.g. position, temperature and acceleration, as well as smart tags to provide information for the customer about the product and for the company when and where their products are in use. Using PE, it is possible to replace classically prepared sensors and smart tags, which have to be glued or fixed to the product, with directly printed functional devices onto the product or packaging itself. Further, printing provides greater flexibility in variation of designs and geometries as may be desirable for security-related applications.

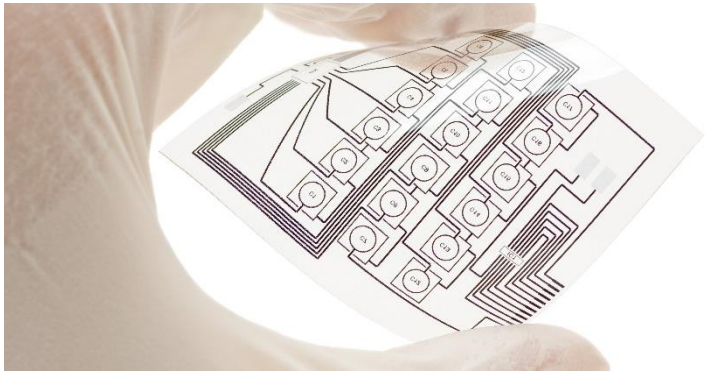
Smart textiles

Functionalities of textiles can be many-fold and include, e.g., health monitoring, motion detection, lighting, safety features, and much more – the varieties of possibilities to functionalize the clothes of the future are endless. The opportunities for the fabrication of smart textiles are almost as diverse as the applications - they range from printing onto the textiles to integrating printed flexible devices into the fabric, to printing the textile itself.

Printed logics

Simple logics with little demands on speed and complexity can already be printed. Using organic and inorganic semiconductors, a CMOS-like transistor circuits can be prepared to make digital circuits possible. Especially in small batch production and flexible substrate applications, printed logics are highly applicable, as PE technology in this field promises low energy consumption and production cost. Circuits like latches, physically unclonable functions, logic gates, and ring-oscillators are possible already, while more complex circuits such as flip-flops, adders and amplifiers are under development.

Figure 1: Example of nano-enabled printed electronics



Current Projects

- Printed Smart Tags:
  Providing "proof of presence" as natural as a handshake using PE technology for interaction with touchscreen devices. Applications range from retail and logistics to engineering (data collection) and security. Status: Following a successful proof of product, we are currently transferring the project to the pilot phase (Partners: TicTag, Hahn-Schickard, InnovationLab, KIT, Fraunhofer IPA, Bosch) Application for funding through SME Instrument.
- Printed Electronics on Curved Surfaces (SHAPETRONICS):
  Development of technologies to apply functional printed structures directly onto 3d-objects. Status: Applying for Funding. (Partner: CRM Group, Fraunhofer IFAM, Hahn-Schickard, KIT)
- Smart Textiles and Sensors:
  Product design and commercialization of integrated sensors in textiles for medical application. Status: Preparatory works. (U Bologna, Centexbel, Denkendorf, KIT)
- Organic Electronics:
  Development of fabrication processes and upscaling of organic electronic devices. Status: In preparation. (Partner: BASF, CEA, DoMicro)