PolyNet

Demonstrator Fact Sheet

Nano-Imprint Lithography

The Research Collaboration project “Nano-Imprint Lithography” within PolyNet aims at showing the feasibility of imprinting organic thin film transistors with sub-µm resolution in a roll-to-roll process. This technological combination goes significantly beyond today’s state-of-the-art.

Sub-µm channels enable device speeds beyond 10MHz, which for example are suitable for RFID applications and organic devices with limited mobilities of about 0.1 cm^2/Vs. Furthermore, R2R-fabrication makes industrial scale output possible.

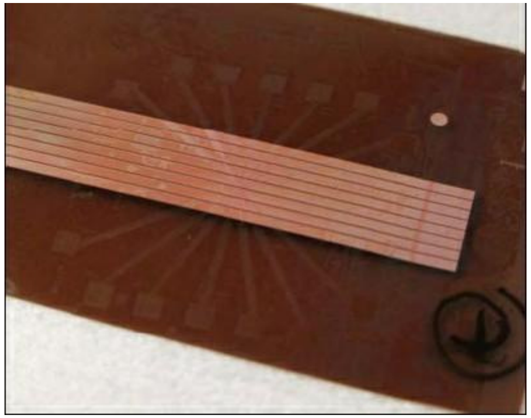


Figure: nano-imprinted channels

The substrate-Gate-Dielectric stack (by Fraunhofer IZM) and the imprint of S/D on top (VTT) are fully carried out by R2R for feasibility demonstration. The finishing of devices with residual etches the S/D metallisation plus lift-off (Joanneum Research) as well as the application of organic semi-conductors (imec, JR) are all performed on lab-scale. Tools for sub-µm imprinting are fabricated at Cardiff University.

Contact: Herbert Gold, Joanneum Research (JR) (herbert.gold@joanneum.at)

Partners: JR, CARDIFF, FHGIZM, VTT, IMEC, LIVUNI, CEA

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

SEVENTH FRAMEWORK PROGRAMME

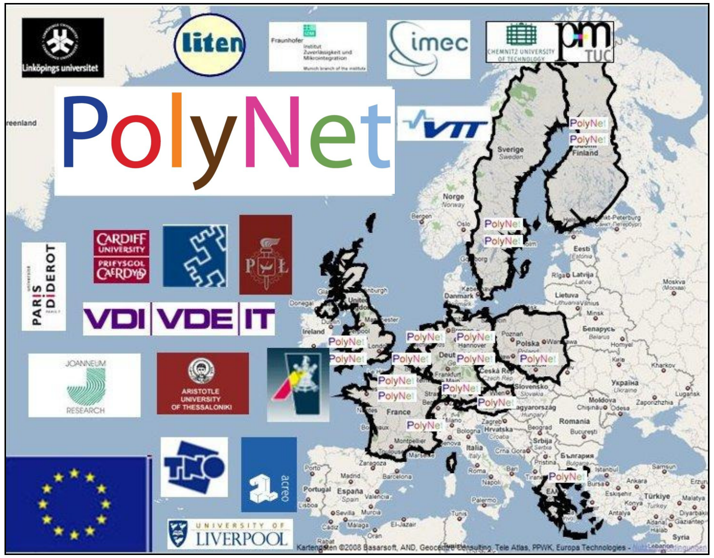
PolyNet

About PolyNet

The NoE PolyNet (Network of Excellence for the Exploitation of Organic and Large Area Electronics / OLAE) aims at establishing Europe in the field of OLAE as the world leader in science, technology development and subsequent commercial exploitation of printing and large area technologies for heterointegration of flexible electronics. It has been designed to

- Overcome the fragmentation of the European research landscape in order to foster transfer from science to industry within the EU
- Develop concepts for the continuation of research cooperation and service offers for a long-term integration of the European research landscape

Impact is expected not only on the research landscape of Organic and Large Area Electronics but also indirectly on European industry by long-term stimulation of innovative technologies and new business development.



Contact:

Constantin von Dewitz
Constantin.vonDewitz@vdivde-it.de
phone (fax) +49 30 310078 -328 (-223)

VDI/VDE Innovation + Technik GmbH
Steinplatz 1
10623 Berlin / Germany

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

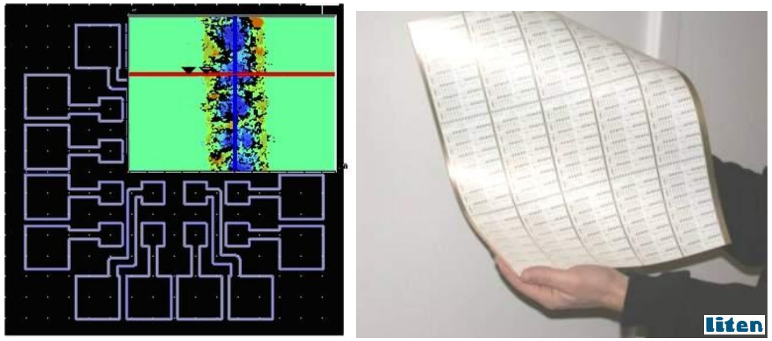
SEVENTH FRAMEWORK PROGRAMME

Demonstrator Fact Sheet

Laser Ablation

This research collaboration within PolyNet is dedicated to the opportunities of laser microstructuring processes for organic and large-area electronics (e. g. anode structures for OLED/OPV applications). A special focus is set upon the integration into roll-to-roll or printing techniques.

In 2010, the project has been dedicated to flat-profile excimer laser ablation for a structuring of ITOs as transparent conductive oxides (TCO) electrodes with a precision down to several micrometers.



Left: A typical layout for microstructuring with lasers (inset: depth profile)
Right: Au patterned on PEN by high-throughput excimer laser for Organic CMOS

The demonstrators represent a preliminary anode layout specifically designed for an effective testing of process parameter windows for ablation. This has been performed at the industrial excimer laser plant of CEA, St. Etienne, France. After having characterised the structure at CARDIFF and VTT, the successful manufacturing of an OLED prototype could be proven by VTT.

Contact: Thomas Blaudeck, Technische Universität Chemnitz (TUC) (thomas.blaudeck@mb.tu-chemnitz.de) & Isabelle Chartier (CEA) (isabelle.chartier@cea.fr)

Partners: Technische Universität Chemnitz (TUC), Acreo AB, CEA, VTT, Cardiff University, Linköping Universitet (LIU)

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

SEVENTH FRAMEWORK PROGRAMME

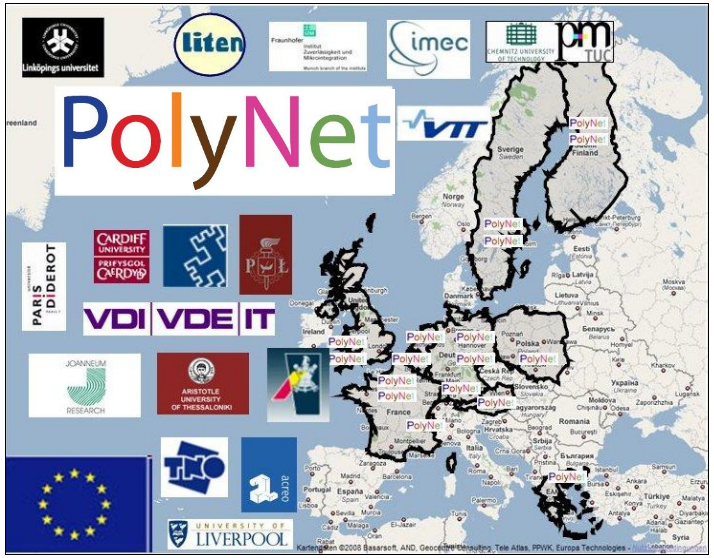
PolyNet

About PolyNet

The NoE PolyNet (Network of Excellence for the Exploitation of Organic and Large Area Electronics / OLAE) aims at establishing Europe in the field of OLAE as the world leader in science, technology development and subsequent commercial exploitation of printing and large area technologies for heterointegration of flexible electronics. It has been designed to

- Overcome the fragmentation of the European research landscape in order to foster transfer from science to industry within the EU
- Develop concepts for the continuation of research cooperation and service offers for a long-term integration of the European research landscape

Impact is expected not only on the research landscape of Organic and Large Area Electronics but also indirectly on European industry by long-term stimulation of innovative technologies and new business development.



Contact:
Constantin von Dewitz
Constantin.vonDewitz@vdivde-it.de
phone (fax) +49 30 310078 -328 (-223)
VDI/VDE Innovation + Technik GmbH
Steinplatz 1
10623 Berlin / Germany

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

SEVENTH FRAMEWORK PROGRAMME

Demonstrator Fact Sheet

Thin-Film Batteries

This collaboration channels the efforts of Europe's top-tiers in the field, each of whom have set the ground with respect to design, materials, or processing. The fabrication processes are characterised by a high yield and reproducibility.

In 2010, this project is dedicated to Thin-Film Batteries made with zinc and bio-compatible laccase electrodes by the means of printing techniques. This approach focuses the expertise on ZnMn systems independently gained at TUC and ACREO as well as of VTT on laccase-based systems. The aim is to present the general printability of chosen electrodes and current collector materials. Also, the influence of manufacturing parameters on the morphology of produced layers and the performance of the manufactured hybrid cells are shown.

A typical flexible thin film battery

The displayed demonstrator represents a printed battery based on a lab-based modular manufacturing technique for thin-film batteries. It has been developed by TUC as well as Fraunhofer ENAS and Menippos GmbH (now Printechnologics GmbH), which all are located in Chemnitz, Germany.

Contact: Thomas Blaudeck, Technische Universität Chemnitz (TUC) (thomas.blaudeck@physik.tu-chemnitz.de) & Ulrike Geyer (TUC) (ulrike.geyer@mb.tu-chemnitz.de)

Partners: Technische Universität Chemnitz (TUC), Acreo AB (ACREO) CEA, VTT, TNO, Oulun Yliopisto (UOULU)

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

SEVENTH FRAMEWORK PROGRAMME

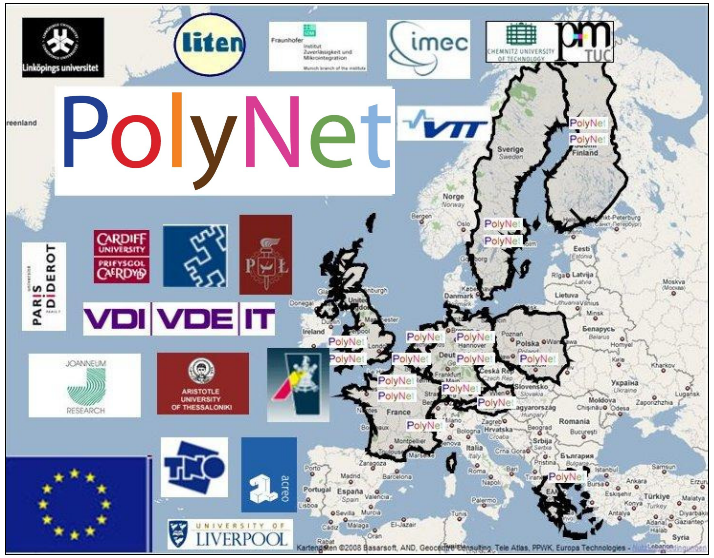
PolyNet

About PolyNet

The NoE PolyNet (Network of Excellence for the Exploitation of Organic and Large Area Electronics / OLAE) aims at establishing Europe in the field of OLAE as the world leader in science, technology development and subsequent commercial exploitation of printing and large area technologies for heterointegration of flexible electronics. It has been designed to

- Overcome the fragmentation of the European research landscape in order to foster transfer from science to industry within the EU
- Develop concepts for the continuation of research cooperation and service offers for a long-term integration of the European research landscape

Impact is expected not only on the research landscape of Organic and Large Area Electronics but also indirectly on European industry by long-term stimulation of innovative technologies and new business development.



Contact:

Constantin von Dewitz
Constantin.vonDewitz@vdivde-it.de
phone (fax) +49 30 310078 -328 (-223)

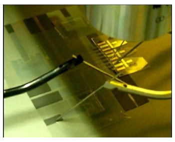
VDI/VDE Innovation + Technik GmbH
Steinplatz 1
10623 Berlin / Germany

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

SEVENTH FRAMEWORK PROGRAMME

Demonstrator Fact Sheet

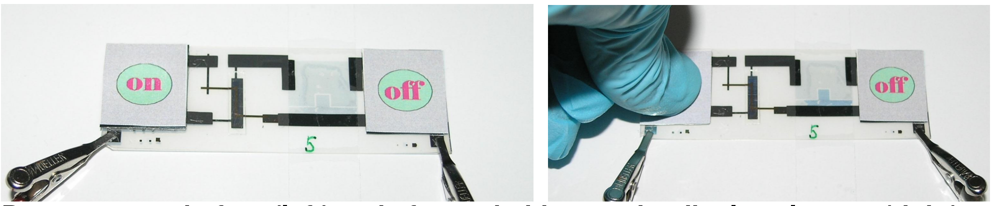
Component Integration



The Research Collaboration project “Component Integration” is conducted within the framework of Polynet. It aims at developing process integration strategies for different classes of organic electronic components. In this scope it has previously been demonstrated that anisotropically conductive adhesives can be used to assemble ready processed single components, e.g. touch sensors, organic thin film transistors (OTFT) and electrochemical (EC) displays. Sensor systems able to convert sensor signals to a visually detectable output have successfully been demonstrated as well.

In 2009, a demonstrator has been realised where all components have been integrated by a fabrication on common single substrates. The respective circuit includes two push buttons and a resistor as well as an OTFT and an EC display. Applied processes include, amongst other things, vacuum steps for metal and organic semiconductor evaporations and printing steps for the patterning of conducting lines and electrolytes. The integration is realised by a careful coordination of process steps. First, conducting lines were evaporated at Acreo, where conducting lines and resistors were printed as well. After that, the samples were cut to single modules and sent to JR for an OTFT processing. Finally, the samples were sent back to Acreo for electrolyte printing and encapsulation and lamination of touch sensor top contact layer. The shadow masks used were prepared by Fraunhofer-IZM-M.

The demonstrator is shown in the figure below. After pressing the “on” button, the OTFT will turn on. It updates the display element and makes it change to a dark blue colour. After pushing the “off” button the display element is short-circuited and de-coloured again. The applied DC voltage is 4.5 V.



Demonstrator before (left) and after switching on the display element (right).

The goal for 2010 is to demonstrate a general solution for an integration of components and subsystems. The idea is to realise components and/or integrated subsystems first, which will later on be integrated into (larger) systems. A lamination to a printed circuit foil (PCF) will be used. Different approaches for PCF will be investigated and the plan is to realize three different demonstrators.

Contact: Petronella Norberg, ACREO AB (petronella.norberg@acreo.se)

Integration Project Partners: ACREO AB (ACREO), CEA, Fraunhofer EMFT (formerly FhG-IZM-M), IMEC, Joanneum Research (JR), Linköping University (LIU), TNO, Technische Universität Chemnitz, (TUC), VTT

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

SEVENTH FRAMEWORK PROGRAMME

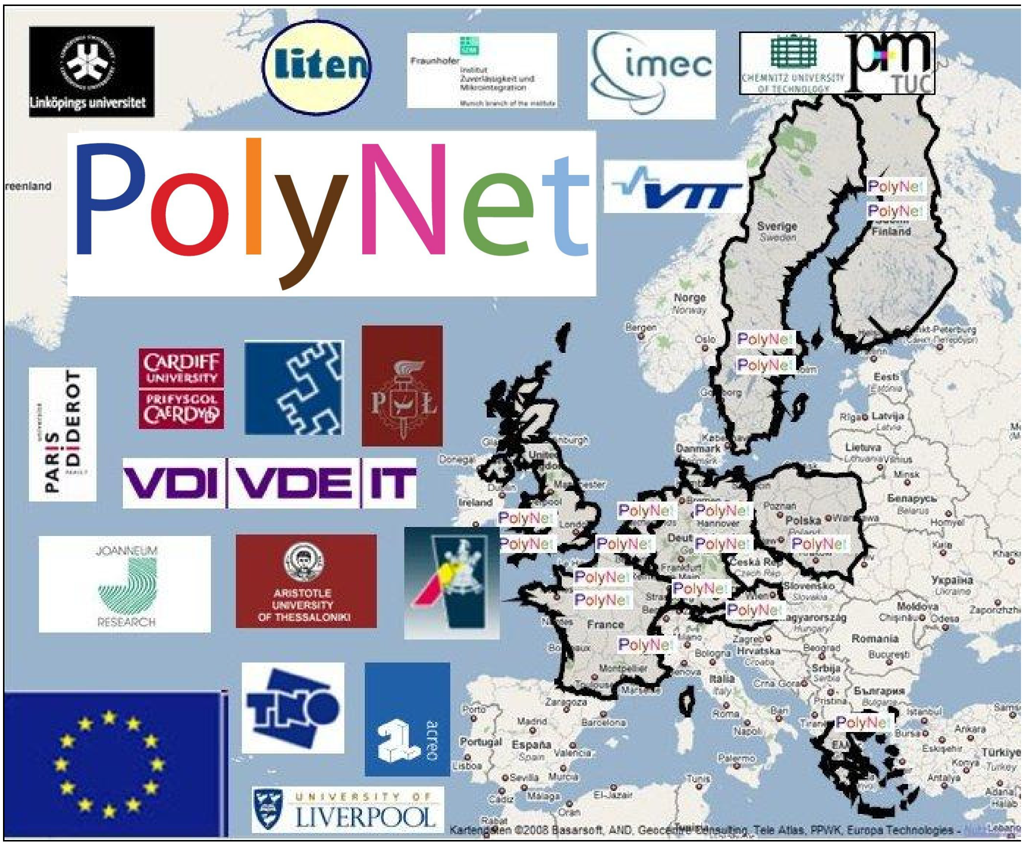
PolyNet Research, Services & Knowledge for Organic and Large Area Electronics

About PolyNet

The NoE PolyNet (Network of Excellence for the Exploitation of Organic and Large Area Electronics / OLAE) aims at establishing Europe in the field of OLAE as the world leader in science, technology development and subsequent commercial exploitation of printing and large area technologies for heterointegration of flexible electronics. It has been designed to

- Overcome the fragmentation of the European research landscape in order to foster transfer from science to industry within the EU
- Develop concepts for the continuation of research cooperation and service offers for a long-term integration of the European research landscape

Impact is expected not only on the research landscape of Organic and Large Area Electronics but also indirectly on European industry by long-term stimulation of innovative technologies and new business development.



Contact:

Constantin von Dewitz
Constantin.vonDewitz@vdivde-it.de
phone (fax) +49 30 310078 -328 (-223)

VDI/VDE Innovation + Technik GmbH
Steinplatz 1
10623 Berlin / Germany

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

SEVENTH FRAMEWORK PROGRAMME

www.noe-polynet.eu

PolyNet

Demonstrator Fact Sheet

Development of Organic Device Models

The Research Collaboration “Modelling of Organic Devices” within PolyNet aims at developing various device models for commonly used disordered and polycrystalline organic semiconductors. Such DC and transient models are essential in understanding the operation of the devices, and more importantly in accurate simulations of the organic circuitry, commonly used as functional blocks in numerous low-cost applications. The simulations are critical in improving circuit designs for enhanced performances, and troubleshooting prior to processing thus avoiding unnecessary production costs.

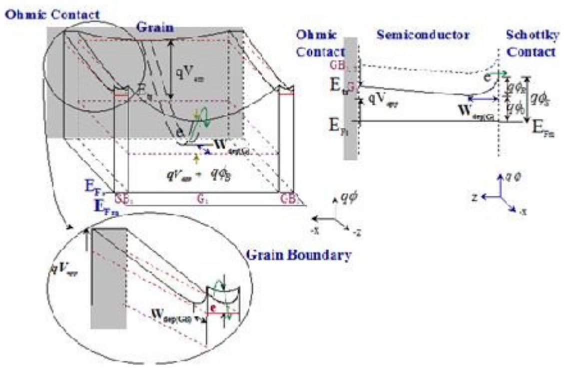


Figure: 2D energy band representation of an n-type polycrystalline Schottky diode with large ordered grains centres (G) and uniform columnar grain boundaries (GB).

Within this collaboration, LIVUNI developed DC-based models for Schottky diodes (as in figure above) and thin-film transistors, in terms of key organic parameters such as grain sizes, Meyer-Neldel temperature and constants related to the dependency of the carrier concentration. Consequently, the parameters are directly related to operational speeds of the circuits. The models were widely validated using data from partners (listed below) on their various technologies i.e. Photolithography and Nano-Imprinting, with various forms of semiconductor i.e. evaporated and soluble derivates of pentacenes.

Contact: Munira Raja (mraja@liv.ac.uk), Organic Electronics Group, Dept of Electrical Engineering & Electronics. University of Liverpool.

Partners: LIVUNI, JR, FHGIZM, IMEC, CEA, UPD, XTEC and TUL

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

SEVENTH FRAMEWORK PROGRAMME

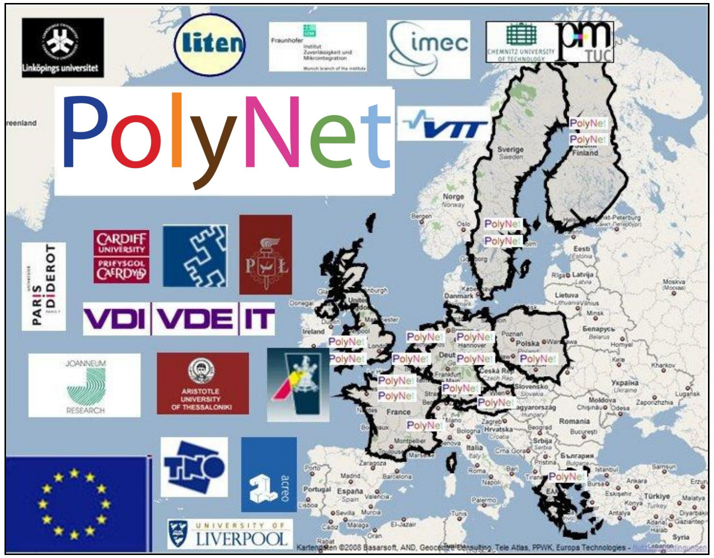
PolyNet

About PolyNet

The NoE PolyNet (Network of Excellence for the Exploitation of Organic and Large Area Electronics / OLAE) aims at establishing Europe in the field of OLAE as the world leader in science, technology development and subsequent commercial exploitation of printing and large area technologies for heterointegration of flexible electronics. It has been designed to

- Overcome the fragmentation of the European research landscape in order to foster transfer from science to industry within the EU
- Develop concepts for the continuation of research cooperation and service offers for a long-term integration of the European research landscape

Impact is expected not only on the research landscape of Organic and Large Area Electronics but also indirectly on European industry by long-term stimulation of innovative technologies and new business development.



Contact:

Constantin von Dewitz
Constantin.vonDewitz@vdivde-it.de
phone (fax) +49 30 310078 -328 (-223)

VDI/VDE Innovation + Technik GmbH
Steinplatz 1
10623 Berlin / Germany

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.

SEVENTH FRAMEWORK PROGRAMME

PolyNet

Demonstrator Fact Sheet

Ordered layers

The Research Collaborative project "Ordered layers and wires of organic semiconductors for large area flexible electronics" was dedicated to the production of Organic Field Effect Transistors (OFETs) with performance fulfilling the industrial requirements. The work was concentrated on the elaboration and optimisation of the organic material processing conditions leading to reducing the production steps, e.g. by fabrication of multifunctional composites suitable to fulfil two or more functions when incorporated in organic electronic devices.
One of the main objectives in this RC project were effective methods of processing which yield in a reproducible way ordered active layers with well defined morphology and properties. It was demonstrated, that by proper adoption of the original, low-cost and solution based zone-casting method it is possible to obtain from one solution, in one batch process, the bi-functional composites for OFET application. These composites consist of highly oriented semiconducting crystals immersed in polymer matrix, that serves at the same time as the support for the semiconducting crystals and as the gate dielectric.

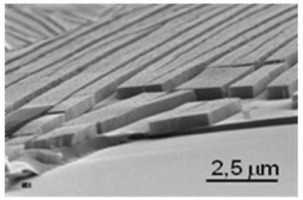


Figure: SEM image of cross-section of the bifunctional composite semiconductor/dielectric polymer for OFET application.

The described bi-functional composites were used to construct OFETs with bottom gate, top contact configuration, which show high charge carrier mobility.
The elaborated simple, one-step processing procedure of producing bifunctional composites which allows to reduce significantly the costs and facilitates the fabrication of organic transistors was subject of patent submission P-388520 (10. 07. 2009).

Contact: Jacek Ulanski (jacek.ulanski@p.lodz.pl), Technical University of Lodz, Poland
Partners: AUTh, CU, IMEC, LIU, TUL, UOULU, UPD, VTT

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.
SEVENTH FRAMEWORK PROGRAMME

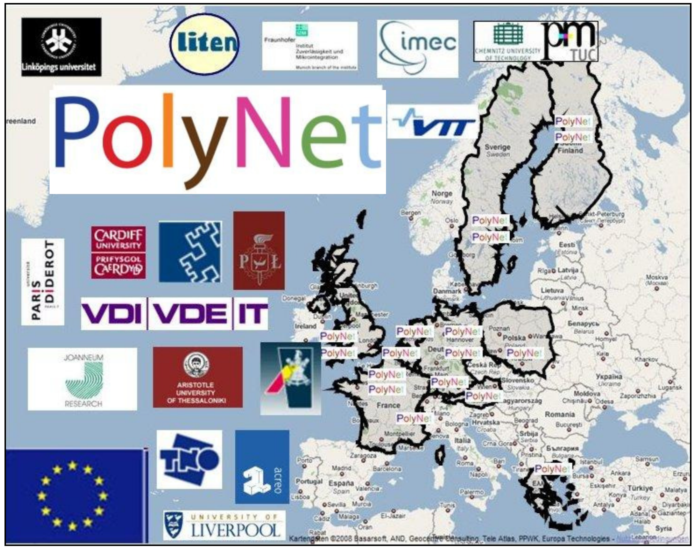
PolyNet

About PolyNet

The NoE PolyNet (Network of Excellence for the Exploitation of Organic and Large Area Electronics / OLAE) aims at establishing Europe in the field of OLAE as the world leader in science, technology development and subsequent commercial exploitation of printing and large area technologies for heterointegration of flexible electronics. It has been designed to

- Overcome the fragmentation of the European research landscape in order to foster transfer from science to industry within the EU
- Develop concepts for the continuation of research cooperation and service offers for a long-term integration of the European research landscape

Impact is expected not only on the research landscape of Organic and Large Area Electronics but also indirectly on European industry by long-term stimulation of innovative technologies and new business development.



Contact:
Constantin von Dewitz
Constantin.vonDewitz@vdivde-it.de
phone (fax) +49 30 310078 -328 (-223)
VDI/VDE Innovation + Technik GmbH
Steinplatz 1
10623 Berlin / Germany

The NoE PolyNet receives funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 214006.
SEVENTH FRAMEWORK PROGRAMME