

Technical University of Denmark



High Current Printed Transistor: Roll-to-Roll Manufacture and Thermal Behavior

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Materials

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Advanced materials for printing

Printed Electronics is an emerging field in which conventional printing technologies, both analog and digital, are utilized to manufacture a variety of electronic devices thanks to the development of a wide range of solution processable functional materials, including metals, insulators, and semiconductors.

Scope:

The scope of the symposium is to collect innovative ideas in the field of Printed Electronics. This subject has promised to revolutionize the manufacturing of electronic devices, achieving very low fabrication costs of large area devices thanks to additive, low temperature processes, and on the other our daily life, promoting the ubiquitous applications of microelectronics and sensors in wearable components and conformable devices. Additive fabrication process is in contrast to traditional micro-fabrication processes that rely critically on subtractive patterning. Nanostructured / nanoengineered materials are ideal additive building blocks for additive processes such as those used in Printed Electronics, since they allow control over size distribution, dimensionality and carrier wavefunctions confinement, any physical / chemical property. Traditional high throughput printing of plastic sheets, paper, fabric, is done using fast rotary machines. Printed Electronics technologies involve the same **analog** process, in particular screen printing, gravure printing / imprinting, flexographic printing. The contact between the transferred ink and the desired substrate, its subsequent motion under the joint influence of surface tension interaction with the substrate, the evaporation of the solvent, the time-dependent viscosity of the variable mass ink system, the interaction with the ambient in terms of temperature and humidity, the post-printing treatments to induce functional properties (e-beam, light, UV, laser, thermal, microwave, magnetic, etc.), are all examples of the aspects evaluated by actual research. Besides this, **digital** processing involves a layer by layer construction of two-dimensional or three-dimensional objects using a liquid ink fed into a printhead, operated by an electronic driver thanks to a transducer (piezoelectric, piroelectric, magnetostrictive, electroacoustic, magnetohydrodynamic, etc.

Hot topics to be covered by the symposium:

- Digital Printing (thermal inkjet, piezoelectric, magnetohydrodynamic, new approaches, fully printed circuits, new functional inks like CNTs, graphene, graphene oxide, sintering, electronic, magnetic, surface and photonic properties of printed materials);
- Analog Printing (roll-to-roll, gravure, flexography, rotary serigraphy, fully printed circuits, new functional inks, electronic, magnetic, surface and photonic properties of printed materials);
- Emerging Roll-to-Roll equipments (R2R Sputtering, R2R Atomic Layer Deposition);
- Substrate Materials – Nanocellulose, Paper, Silk, Technopolymers;
- Technologies (plasma treatments, laser drilling and processing).

Tentative list of invited speakers:

- Ronald Österbacka, Åbo Akademi University – «*Printed Electronics on Paper*»
- Graham Martin, Uni Cambridge - «*Latest in inkjet technology*»

Tentative list of scientific committee members:

- M. Caironi, Center for Nanoscience and Technology, Istituto Italiano di Tecnologia, Italy
- Jukka Hast, VTT Technical Research Centre of Finland
- Stefan Güttler, Media University, Stuttgart, Germany
- Martin Möller, DWI – Leibniz-Institut für Interaktive Materialien e.V., Aachen, Germany

START AT	SUBJECT	View All	NUM.	ADD
SESSION 1 : -				
13:30	Tougher and Stronger Carbon Fibre Composites that contain Inkjet Printed Polymers		F.1.1	☆
14:00	Wearable Electronic Devices with Stretchable and Transparent Designs using High-Resolution 2D/3D Printing Techniques		F.1.2	☆

START AT	SUBJECT	NUM.	ADD
14:20	Ultrasonic Spay Coating as a versatile technique for the large area deposition of functional nanoparticles	F.1.3	☆
14:40	Relief printing of micron sized electrical conductive structures on silicon	F.1.4	☆
15:00	Assessment of conductive and dielectric inks for modified gravure printer	F.1.5	☆
15:20	<i>Break</i>		
16:00	<p>High Current Printed Transistor: Roll-to-Roll Manufacture and Thermal Behavior</p> <p>Authors : Francesco Pastorelli, Thomas M. Schmidt, Markus Hösel, Roar R. Søndergaard, Mikkel Jørgensen and Frederik C. Krebs</p> <p>Affiliations : Solar group, Energy department, Technical University of Denmark, Roskilde, Denmark</p> <p>Resume : The footprint of organic electronic technologies is important when united in complex circuitry. We present flexible organic power transistors prepared by fast (20?m?min?1) roll-to-roll flexographic printing of the drain and source electrode structures, with an interspace below 50 um, directly on polyester foil[1]. The devices have top gate architecture and were completed by slot-die coating of the organic semiconductor poly-3-hexylthiophene and the dielectric material polyvinylphenol before the gate was applied by screen printing. We explore the footprint and the practically accessible geometry of such devices with a special view toward being able to drive large currents while handling the thermal aspects in operation together with other organic printed electronics technologies such as large area organic photovoltaics (OPV) and large area electrochromic displays (EC). We find especially that an elevated operational temperature is beneficial with respect to both transconductance and on/off ratio. We achieve high currents of up to 45?mA at a temperature of 80?°C with an on/off ratio of 100 which is sufficient to drive large area organic electronics such as an EC device powered by OPV devices that we also demonstrate. Finally, we observe a significant temperature dependence of the performance which can be explored further in sensing applications. [1] Francesco Pastorelli, Thomas M. Schmidt, Markus Hösel, Roar R. Søndergaard, Mikkel Jørgensen and Frederik C. Krebs, " The Organic Power Transistor: Roll-to-Roll Manufacture, Thermal Behavior, and Power Handling When Driving Printed Electronics", Volume 18, Issue 1, pages 51?55, January 2016, doi: 10.1002/adem.201500348</p>	F.1.6	☆
16:20	Roll-to-Roll manufacturing of Organic Photovoltaics in pilot line with laser patterning & optical metrology for quality control	F.1.7	☆
16:40	Fabrication and optimization of flexible polymer light-emitting diodes by gravure printing processes	F.1.8	☆
17:00	Soft Lithographic Fabrication of Topographic Meso-scale Patterns with Tunable Feature Height	F.1.9	☆

START AT	SUBJECT	NUM.	ADD
17:20	Nanoparticle networks in polymer thin films for 3D printing	F.1.10	☆
17:40	COMPARATIVE STUDY OF SELECTIVE SINTERING METHODS OF PRINTED METAL PATTERNS ON PAPER SUBSTRATE BY IN-SITU ELECTRICAL RESISTANCE M	F.1.11	☆
START AT	SUBJECT	View All	NUM. ADD
SESSION 2 : -			
09:00	Paper Electronics Using Environmentally Friendly Devices	F.2.1	☆
10:00	<i>Break</i>		
10:30	Synthesis of Cu-Ag core-shell nanowires for transparent conductive film applications	F.2.2	☆
10:50	In-situ study of pyrolysis of the thick deposited YBa ₂ Cu ₃ O ₇ precursor layers by ink jet printing	F.2.3	☆
11:10	Effect of dispersion medium on rheology and solid concentration of aqueous based Cu nanoparticle ink for inkjet printing	F.2.4	☆
11:30	Contact resistance between printed metal and transparent conductive oxides	F.2.5	☆
11:50	Fully-Printed Zinc Oxide Electrolyte-Gated Transistors on Paper	F.2.6	☆
12:10	<i>Lunch</i>		
14:00	Polyaniline: from preparation to application in printing processes	F.2.7	☆
14:30	3D printed nanocarbon microwave absorbers	F.2.8	☆
14:50	Flexible and stretchable conductive tracks fabricated by inkjet-printed CNTs	F.2.9	☆
15:10	Inkjet printing highly conductive reduced graphene oxide patterns for humidity sensor application	F.2.10	☆
15:30	Inkjet printing of fullerenes free, semitransparent, Near Infrared (NIR) photodetectors based on small bandgap copolymers	F.2.11	☆

START AT	SUBJECT	NUM.	ADD
15:50	High concentration aqueous graphene-based inks for screen and flexographic printed electrodes	F.2.12	☆
16:10	<i>Break</i>		
	Poster Session : -		
16:30	Printed Thin Film Transistors on Nanofibrillated Cellulose Substrate	F.3.1	☆
16:30	Inverted photodiode with ZrO ₂ :ZnO blend as an electron injection layer for achieving low dark current and high detectivity	F.3.2	☆
16:30	Digitally-controllable organic vapor-jet printing for the straightforward fabrication of printed electronic devices	F.3.3	☆
16:30	Novel surfactant engineering for producing water-borne colloids of polymeric semiconductors following high charge carrier mobility	F.3.4	☆
16:30	Synthesis and characterization of Cu-Ni nanowires by low toxicity reducing agent for transparent conducting film application	F.3.5	☆
16:30	Gradient core-shell HTS/polymer covered composites with ultrafine particles fabricated by 3D printing	F.3.6	☆
16:30	Screen printed Multi-Walled Carbon Nanotubes Thick Films for Tuning Microwave Resonances of Antennas and Ring Resonators	F.3.7	☆
16:30	Reactive Inkjet Printing of Biocompatible Silk Micro-rockets	F.3.8	☆
16:30	Microbes based printing for fabrication of three dimensional structures	F.3.9	☆
16:30	Organic field-effect transistor based temperature sensors for flexible medical applications	F.3.10	☆
16:30	Au and Ag metal films sputtered on printer paper	F.3.11	☆
16:30	Photonic sintering of conductive nanomaterial inks for printed electronics	F.3.12	☆
16:30	Deposition of coiled silver nanowire ring by electrostatically spray-coating method	F.3.13	☆

START AT	SUBJECT	NUM.	ADD
16:30	Bio-inspired ultra thin and high conductive silver thin film patterning by EHD jet printing method	F.3.14	☆
16:30	CARBON-GOLD NANOCOMPOSITE FOR THE DETERMINATION OF MERCURY	F.3.15	☆
16:30	Highly Stable Hybrid Silver Nanowire Electrode for Flexible Electronics	F.3.16	☆
16:30	Printable cellulose-based electroconductive composite film for paper electronics	F.3.17	☆
16:30	Inkjet Printing of Conductive Silver Patterns on Flexible Polymers from Saline Precursors in Aqueous Solution mixed with Dishwashing Detergent	F.3.18	☆
16:30	Electro photographic toner particles: Generation and surface functionalization of methacrylic microparticles for the assembly of three-dimensional objects	F.3.19	☆
16:30	Printed indium oxide thin-film transistors and inverters on flexible substrates	F.3.20	☆
16:30	Ag Nanocomposite Printed Resistive Switching Device: The Future Memory	F.3.21	☆
16:30	Cu, Cu-Au and Ni nanostructured electrodes synthesized by laser-induced deposition from solution for the non-enzymatic sensing	F.3.22	☆

No abstract for this day

No abstract for this day

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Symposium organizers

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