Introduction to Organic and Printed Electronics

Visit of Japanese Delegation to drupa2016

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drupa, Düsseldorf, Germany

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Organic and Printed Electronics
Ambient intelligence – Electronics everywhere

Organic and Printed Electronics

- thin
- robust
- flexible
- light-weight

low-cost electronics
new applications
single-use disposable electronics
Organic and Printed Electronics
Examples of OPE

- Active and passive electronic devices
- Displays and lighting
- Power supply
- Sensors

Smart Systems

Image source: PolyIC, Fraunhofer ISE, Thinfilm, Plastic Logic
Organic and Printed Electronics
Interaction of several fields

Printed Electronics

Printing
Chemistry
Microelectronics

Image sources: Holst Centre, Coatema, Cynora, Infineon

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Basics of Organic and Printed Electronics
Printing & Patterning

rotogravure printing

offset printing

inkjet printing

flexographic printing

screen printing
New Functional Inks and Substrates

Soluble Functional Materials
- Polymers
- Metal filled pastes
- Nanoparticles

Substrates
- Paper
- Plastic
- Glass
- Stainless Steel

The material best suited for specific application depends on process conditions, surface roughness, thermal expansion, barrier properties.
Basics of Organic and Printed Electronics

High requirements on processing

- Pin: 0.5 mm
- Organic Solar Cell (active layers): 0.25 µm
- Football: 22 mm
- Human Hair: 50 µm
OE-A - Overview

Global industry association for organic and printed electronics, driven by over 230 international members

A working group within VDMA

private, non-profit organization

Our members represent the entire organic electronics value chain:

» Component & material suppliers
» Equipment & tool suppliers
» Producers / system integrators
» End-users
» R&D institutes & universities
OE-A - Overview

Our Services:

» Networking Opportunities
» Frequent Working Group Meetings
  – Europe
  – North America
  – Asia
» LOPEC
» Industry Roadmaps
» Demonstrator Projects
» Industry Visibility
Board of Directors

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Cooperation with Japan

Vice Chairman of the OE-A Board:
Prof. Toshihide Kamata, AIST

Long standing cooperation with Japan:
» Roundtables
» Conferences
» Seminars at exhibitions and trade shows
» Joint Working Group Meetings with JAPERA / JAPIC
230+ Members
Representing the entire value chain (1)
230+ Members

Representing the entire value chain (2)
LOPEC 2017, March 27-29
ICM Munich, Germany

The central marketplace for Organic and Printed Electronics

- 2,300+ attendees
- 140+ international exhibitors
- 190+ presentations

Exhibition
- Largest industry exhibition in the field
- On-site production on demo line

Conference
- Business, Technical, Scientific Conference
- Pre-conference seminars

10% discount for OE-A members

Call for Papers
Sep 01 – Oct 15, 2016
Organic and Printed Electronics
A Future Multi-Billion $ Market

Organic electronics enables new applications and opens new markets

2015: 24.5 Bn US$, predominately by OLED displays

Potential for a 50 Bn US $ market within the next 10 years driven by lighting, displays, OPV, logic, memory / RFID, sensors
Packaging identified as one of the major industries for Printed Electronics

» Eye-catching labels
» Interactive packaging
» Security & logistics
» Integration of a diverse range of functionalities
Printing / Packaging / Advertising Applications

Today

Printed Interactive Cards

Interactive Journals, e.g. Esquire, TV Movie
  • Display, PV, Batteries, LED

Interactive Pricetags and Smart Shelves

Interactive Posters
  • Electroluminescence, Motion Sensors

Tickets

Smart Packages with Printed Lighting Elements

Image sources: Karl Knauer, Ynvisible, OE-A
Printing / Packaging / Advertising Applications
Tomorrow

- Smart Labels, e.g. Time-Temperature Indicators
- Interactive Newspapers
- Intelligent Packaging
- Interactive Billboards
- Printed RFID tags

Image sources: Thinfilm, Holst Centre, OE-A, Messe München, PolyIC
Interactive Journals

Past

» Conventional electronics (Si), thick & rigid
» Examples
  – E-ink cover page, Esquire
  – embedded video player in a print ad, TV Movie
  – solar-powered LEDs cover page / ad, TV Movie

Future

» Thin & flexible displays, printed chips and batteries
Luminous Packaging

Illuminated box for bottles (cardboard)

» Printed electroluminescence
» Light animation is triggered by picking up the box
» German Packaging Award 2012

Launched January 2013 by Karl Knauer KG, Germany
www.karlknauer.com
NFC: Smart Labels

Printed NFC labels

» Anti-theft / brand protection with integrated sensors
» Customer interaction, enabling cross media applications

Targeting:

» Brand owners
» Pharmaceuticals
» Luxury goods

Launched 2015 by Thin Film Electronics
ASA, Norway

www.thinfilm.no
Healthcare Applications

Today

Diagnostic electrodes

Printed flexible electrodes for ECG, EEG, EOG

Printed glucose & cholesterol test strips

Therapeutic electrodes

Laboratory analytical electrodes

Smart pharmaceutical blister package for field trials

Image sources: Holst Centre, VTT, Cidetec, Corbis
Healthcare Applications
Tomorrow

Smart clothing, embedded with motion & physiological sensors

Flexible textile sensors in mattresses

Smart patches: light therapy, drug delivery, temperature sensing

OLED blankets for phototherapy

Smart packages to support patient compliance

Flexible displays integrated in package for patient information

Anti-counterfeit

Packaging integrated RFID for logistics

Image sources: Philips, Fraunhofer EMFT, Acreo, Holst Centre, Cetemmsa, PolyIC, Acreo
Smart Packaging in Healthcare Applications

Smart Blister for Pills

» Hybrid system with printed sensor grid, integrated in blister package
» Integrated NFC
» Monitoring of medication intake, e.g. in clinical trials

Med-ic by imc
http://www.informationmediary.com/med-ic
OE-A Roadmap for Organic and Printed Electronics
6th Edition

Key activity of the OE-A
Represents members’ perspectives (230+)
Short, medium & long-term forecasts
Identification of red brick walls
Target groups

Updated biannually

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OE-A Roadmap, 6th edition

Overview

OE-A Roadmap for Organic and Printed Electronics Applications 2015

Today

Future

OLED Lighting

Organic Photovoltaics

Flexible and OLED Displays

Electronics & Components

Integrated Smart Systems (ISS)

© OE-A 2015
OE-A Roadmap, 6th Edition

Key Trends

**OLED Displays**
Arrived on mass markets

**Major Industries**
Organic Electronics in
- Automotive
- Consumer Electronics
- White goods
- Pharmaceuticals / Healthcare
- Packaging

**Hybrid Systems**
- Integration of printed and silicon-based components
- Primary path to commercialization

**Organic Photovoltaics**
- Increased mobility of organic semiconductors
- Increased efficiency of OPV
- Competitiveness with poly-Si in sight

**Patterning Processes**
- Scaling to smaller dimensions
- Improved registration
OE-A Roadmap, 6th edition
End-user requirements

- Flexibility / bending radius
- Lifetime / stability / homogeneity / reliability
- Complexity of devices
- Efficiency / performance
- Environmental and toxicological safety
- Cost

Different requirements for different applications

Different requirements for different applications

Image source: VTT, ArjoWiggins, PostAuto Schweiz AG

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Forecasts for application clusters

» OLED Lighting
» Organic Photovoltaics
» Flexible & OLED Displays
» Electronics & Components
» Integrated Smart Systems

Short, medium and long term forecasts
The material best suited for a specific application depends on process conditions, surface roughness, thermal expansion, barrier properties.
OE-A Roadmap, 6th edition

Key Technology Parameters

- electrical performance
- yield
- resolution and registration uniformity
- fit of process parameters
- barrier properties and environmental stability

Image source: Heliatek, QC Basler, Fraunhofer ISE

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OE-A Roadmap, 6th edition


» Includes Roadmap summary article as well as information on OE-A and its services
» Available for download at www.oe-a.org/downloads


» Full text, all graphics, 130+ pages
» Members: Free access to printed and pdf version & Annex with detailed tables available
» Non-members: For sale at www.oe-a.org
Collaboration is the key to success

» OE-A supports and facilitates cooperation

» Demonstrators are key activity of OE-A since 2005

» Demonstrators illustrate potential and integration possibilities of organic and printed electronics

OE-A Competition 2017 now starting!
More information:
www.oe-a.org/demonstrator
Upcoming OE-A Meetings

**38th OE-A Working Group Meeting**
- June 28-29, 2016
  - hosted by CPI, Durham, UK
  - Special Topic: Internet of Things & Smart Packaging

**OE-A North America Meet & Greet**
- July 13, 2016
  - San Francisco, CA
  - co-located with Intersolar North America/SEMICON West

**39th OE-A Working Group Meeting**
- October 11-12, 2016
  - hosted by Clariant, Frankfurt/Main, Germany
  - Special Topic: Sustainability of Printed Electronics – Materials & Beyond
Upcoming Events in Japan

ICFPE Yamagata

» September 06-08, 2016
Yonezawa City, Yamagata, JP
OE-A Session “New Technologies and Applications for Printed Electronics”

Printable Electronics Japan

» February 15-17, 2017
Tokyo Big Sight, Tokyo, JP
Joint booth of OE-A members
OE-A Seminar

7th OE-A Asian Working Group Meeting

» Time and venue tba
Conclusion

Organic and Printed Electronics is an enabler for many new applications for numerous industries

International cooperation and networking is key for success of this emerging industry

Intensify the good and long-standing cooperation with Japan.
Where to find us at drupa

OE-A Seminars at drupa cube, hall 6

June 02, 2016
14:10 – 16:00h
Printed Electronics & Smart Packaging

June 07, 2016
11:00 – 13:00h
Printed Electronics – Technologies & Applications

OE-A booth: hall 7.0 B27, dip!

» Infos on OE-A, its members & services
» Infos on OE-A Roadmap
» Examples of smart packaging, illuminated packaging, sensors, OLED, OPV
Thank you
for your attention!