Smart Packaging durch gedruckte Elektronik

Packaging Inspiration Forum

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Wolfgang Mildner, Member of the Board

OE-A
Eine Arbeitsgemeinschaft des VDMA
Frankfurt/Main

www.oe-a.org
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Outline

- Introduction OE-A
- Application Fields
- OE-A Roadmap
Printing Meets Electronics

Source: Heraeus, manroland, Infineon, Karl Knauer
Organic and Printed Electronics Vision

Organic and Printed Electronics is
- thin
- lightweight
- flexible & robust
and enables
- low-cost electronics
- new applications
- single-use electronics

by large area, high volume production

Enables:
- Electronics everywhere
- Ambient intelligence

Source: Konarka, Novaled
OE-A – Overview

- **Global industry association** for organic and printed electronics, driven by over **210** international members

- **Our members represent the entire organic electronics value chain:**
  - Component & material suppliers
  - Equipment & tool suppliers
  - Producers / system integrators
  - End-users
  - R&D institutes

- **Benefits of OE-A membership:**
  - Networking Opportunities
  - Frequent Working Group Meetings
    - Europe, North America, Asia
  - LOPEC
  - Industry Roadmaps
  - Demonstrator Projects
  - Industry Visibility
Global Approach

- Establish a global network

OE-A is active in:
- Europe
- North America
- Asia

Headquarters:
- Frankfurt, Germany

North American Office:
- Pittsburgh, PA., USA

North America
30
US 28, CAN 2

EU
176
DE 85, GB 21, GR 3, GB 21, SE 3, FR 11, DK 2, CH 7, PT 2, AT 6, IE 1, ES 6, NO 1, FI 5, PL 1, IT 5, RO 1, NL 5, RS 1, BE 4, RU 1, CZ 4, SI 1

Asia
12
JP 3, CN 2, KR 2, TW 2, IL 1, SG 1, TH 1

Australia
1

Total: 219 Members from 32 countries
(as of January 2014)

- New Munich Trade Fair Centre, Germany
  - Provides the central marketplace for Organic and Printed Electronics
    - 1,800+ attendees
    - 120+ international exhibitors
    - 180+ presentations

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

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

- 10% discount for OE-A members

- www.lopec.com
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Organic and Printed Electronics
A Future Multi-Billion $ Market

- Organic electronics enables **new applications** and opens **new markets**

<table>
<thead>
<tr>
<th>Multi-Billion US$ Markets Enabled by New Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bn. US$</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>250</td>
</tr>
<tr>
<td>200</td>
</tr>
<tr>
<td>150</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>0</td>
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</tbody>
</table>

**Semiconductors**

**Flat Panel Displays**

**Organic and Printed Electronics**

- **2012**: 8 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

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Organic and Printed Electronics Reach Mass Markets

Pioneers in this area are

- Automotive industry
- Pharmaceutical industry
- Consumer electronics
- Packaging producers

Pictures: Thinfilm, BASF, Karl Knauer, LG
Chances:
Smart Packaging

Integration of
- Displays
- Logic
- Keys
- Sensors
- Memory
- Power supply
- Speakers
- RFID

Source: PacProject
Smart Packaging

Examples:

- Smart Packaging with display
- E-newspaper
Today
- Interactive Journals (Display, PV, batteries LEDs) e.g. Esquire, TV Movie
- Interactive Pricetags and Smart shelves
- Interactive posters: electroluminescent, motion sensors
- Printed Interactive Cards
- Tickets
- Smart packages with printed lighting elements

Tomorrow
- Smart Labels: e.g. Time-Temperature Indicators
- Intelligent packaging
- Interactive newspapers
- Interactive billboards
- Printed RFID tags

Source: Thin Film, Bauer Media, ISORG, Karl Knauer
Intelligent Packaging Applications on the Market

Example: Stora Enzo

- **Pharma / Medicine compliance card**
  - Tracking pill taking, questionnaires, data transfer to computer networks

- **Temperature logger in package**
  - Indicates if in transport min/max temperature has been achieved and when

- **UV-indicator in package**
  - Indicates if too much UV-light has been received during transport

- **eMenu**
  - Wireless, paperboard restaurant menu. Customer orders food and drink by pressing button in menu and the order is send to kitchen.
Temperature Monitoring for Food Packages

Time Temperature Indicator
By: Bizerba, Limatdruck/Zeiler

- Special ink that changes colour according to time and temperature
- Efficient cold-chain can be proved
- Offers consumer an additional indicator to the best before date

Photo: Limmatdruck/Zeiler, Bizerba
Interactive Printed Cards

Invisible digital data storage

- Invisible digital data storage
- Printed on paper or foil
- Read using a touchscreen device

- Crossmedia
- Ticketing
- Brand protection / authenticity check
- Toys and collector’s cards

- Product by: T-Ink, USA

Photo: Printtechnologics
Luminous Packaging

- Illuminated cardboard box for bottles
- Printed electroluminescence
- Light animation is triggered by picking up the box
- New standards for the presentation of a brand at the point of sale and marketing
- German Packaging Award 2012

Product launched January 2013 by Karl Knauer KG, Germany, www.karlknaurer.com
Interactive Journals

- **E-ink cover page**, 2009, Esquire

- **Embedded video player** in a print ad, 2010, TV Movie

- **Solar-powered LEDs** cover page / ad, TV Movie, 2011

- **Today**: classical electronics (Si), thick & rigid

- **Future**: Thin & flexible displays, printed chips and batteries
Future: Intelligent Packaging

Smart Cardbox
- Display
- Logic
- Barcode
- Touch Sensitive Films
- Antenna
- Energy Harvesting / OPV

for
- User Information
- User Interaction
- Identification

by PolyIC, www.polyic.com

Photo: PolyIC
Origami Electronics

Printed electronics and displays on paper electrochromic display

- E.g. for displaying real use-by-date

Blinking package
- „Moving Images“ fully printed on paper

- by Acreo, Sweden
  www.acreo.se

Photos: Acreo
Interactive Graphics

Interactive / changing graphics integrated in traditional printed products

- Electrochromic Display
- Printed Battery
- OPV

for

- Greeting cards
- Sensors
- Bookmarks

Produced by Ynvisible, Portugal

www.ynvisible.com

Photo: Ynvisible
Integrated Disposable Printed Biosensor

- All-printed glucose sensor
- Including
  - Power source
  - Circuitry
  - Sensor
  - Electrochromic display
- Display shows different glucose levels upon applying an analyte of varying concentration to the sensor
- Concept can be utilized for other sensor analytes and mechanisms
- Demonstrator by Acreo, Sweden www.acreo.se
Integrated Printed Time Temperature Indicator with Rewritable Memory

- Including
  - Organic logic circuitry
  - Printed temperature sensor
  - Electrochromic display
  - Battery

- Detects critical temperature thresholds and records data for later retrieval and display.

- Item-level tracking of quality data for goods such as pharmaceuticals and perishable foods

- Under development by Thin Film Electronics ASA, Norway, www.thinfilm.no
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New OE-A Roadmap 2013

OE-A Roadmap for Organic and Printed Electronics Applications

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### Forecast for the Market Entry

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<tr>
<th>OE-A Roadmap for Organic and Printed Electronics Applications</th>
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</thead>
<tbody>
<tr>
<td><strong>Organic Photovoltaics</strong></td>
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<tr>
<td>Portable chargers</td>
</tr>
<tr>
<td>Consumer electronics, customized mobile power</td>
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<tr>
<td>Specialized building integration, off grid</td>
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<tr>
<td>Building integration, grid connected PV</td>
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<tr>
<td>Flexible Displays</td>
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<tr>
<td>Flexible segmented displays integrated into smart cards, price labels, bendable colour displays</td>
</tr>
<tr>
<td>Bendable OLEDs, plastic LCD, in-moulded displays, large-area signage, rollable color displays</td>
</tr>
<tr>
<td>Rollable OLEDs with OTFT, (semi-) transparent rollable displays, flexible consumer electronics</td>
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<tr>
<td>Rollable OLED TVs, telemedicine</td>
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<tr>
<td>OLED Lighting</td>
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<tr>
<td>Design projects</td>
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<tr>
<td>Transparent and decorative lighting modules</td>
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<tr>
<td>Flexible lighting</td>
</tr>
<tr>
<td>General lighting technology</td>
</tr>
<tr>
<td>Electronics &amp; Components</td>
</tr>
<tr>
<td>Primary single-cell batteries, memory for interactive games, ITO-free transparent conductive films</td>
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<tr>
<td>Rechargeable single-cell batteries, transparent conductors for touch sensors, printed reflective display elements</td>
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<tr>
<td>Printed multi-cell batteries, integrated flexible multi-touch sensors, printed logic chips</td>
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<tr>
<td>Directly printed batteries, active and passive devices to Smart Object</td>
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<tr>
<td>Integrated Smart Systems</td>
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<tr>
<td>Garments with integrated sensors, anti theft, brand protection, printed test strips, physical sensors</td>
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<tr>
<td>Integrated systems on garment, large-area physical sensor arrays and mass market intelligent packaging</td>
</tr>
<tr>
<td>Textile sensors on fibre, dynamic price displays, NFC/RFID smart labels, disposable monitoring devices</td>
</tr>
<tr>
<td>OLEDs on textile, fibre-electronics, health monitoring systems and smart buildings</td>
</tr>
</tbody>
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New OE-A Industry Directory
Interactive Cover Page


- Includes
  - Roadmap summary article
  - Company profiles
  - Product & Services directory
  - Addresses, contact details of all members
  - Information on OE-A and its services

- Interactive, light-up cover page
  - Limited edition: 4000 devices produced
  - Screen-printed electronic circuitry, printed battery, printed push button and light-emitting diodes
Organic and Printed Electronics open new markets

From “carton / paper” to “smart packaging” opens new possibilities for value-added products

First products launched, OE-A Roadmap describes the path to the future

Networking and cluster collaboration are key for the future success

OE-A provides the international industry platform

Organic and Printed Electronics will be one of the largest growing markets in the future
Vielen Dank für Ihre Aufmerksamkeit

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