

Flexible technology for flexible markets: Trends in organic and printed electronics

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IARIGAI

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A working group within



OE-A - Overview

Global non-profit **industry association** for organic and printed electronics, driven by over **220 international members**

OE-A is a working group within VDMA

Our members represent the **entire value chain:**

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



Global membership base



OE-A is active in

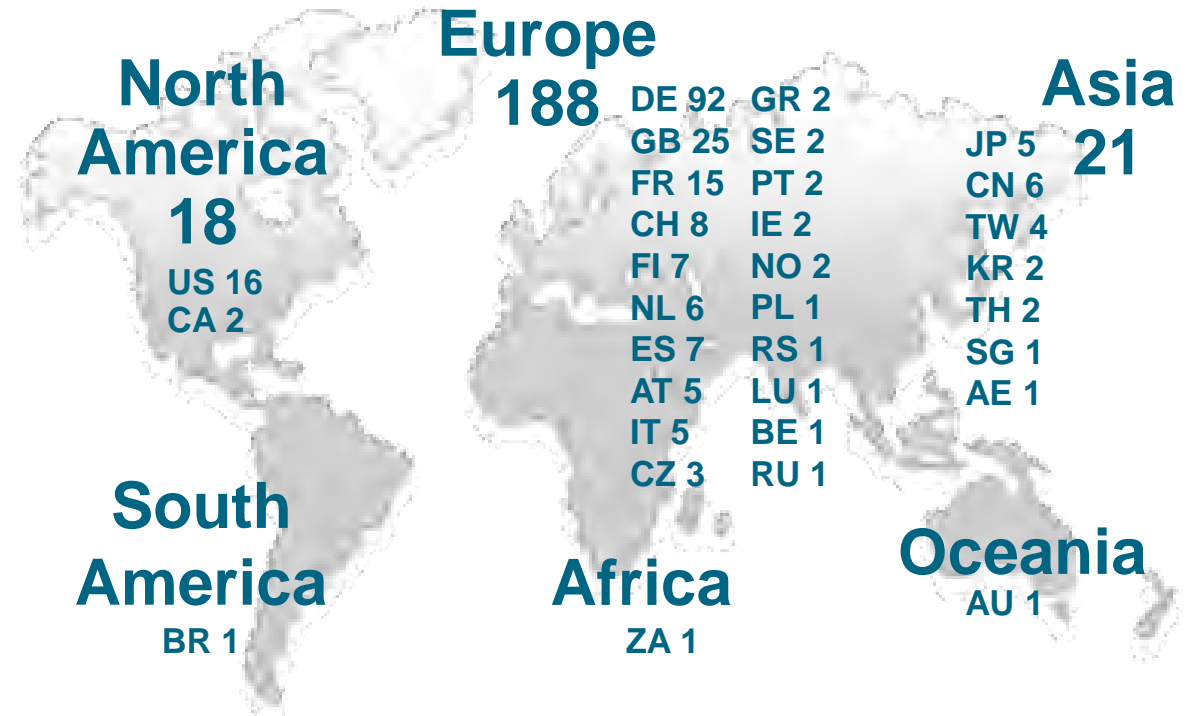
- » Europe
- » North and South America
- » Asia
- » Oceania
- » Africa

OE-A / VDMA Headquarters

- » Frankfurt, Germany

VDMA Representations

- » Berlin, Brussels, Japan, China, India, Brasil, Iran, Russia



Total: 230 Members (as of June 2019)

Your International Networking and Communication Platform



- » Market & technology information
- » Research & development
- » Education & Training
- » Standardization
- » Global visibility
- » Advocacy & funding
- » Networking Opportunities
- » Frequent Working Group Meetings
- » LOPEC
- » Industry Roadmaps
- » Demonstrator Projects
- » Industry Visibility
- » Participation in international exhibitions / joint pavillions
- » Discounts on event tickets



Key Benefits

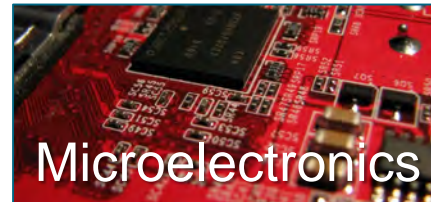
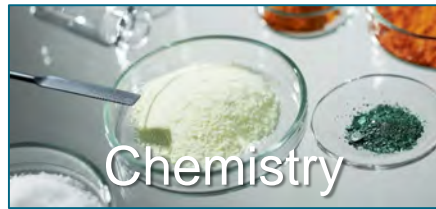
Organic and Printed Electronics is ...

- » Thin
- » Lightweight
- » Flexible
- » Robust

Enabling technology for ...

- » Conformable Sensors
- » Efficient lighting
- » Energy harvesting
- » Low-cost production

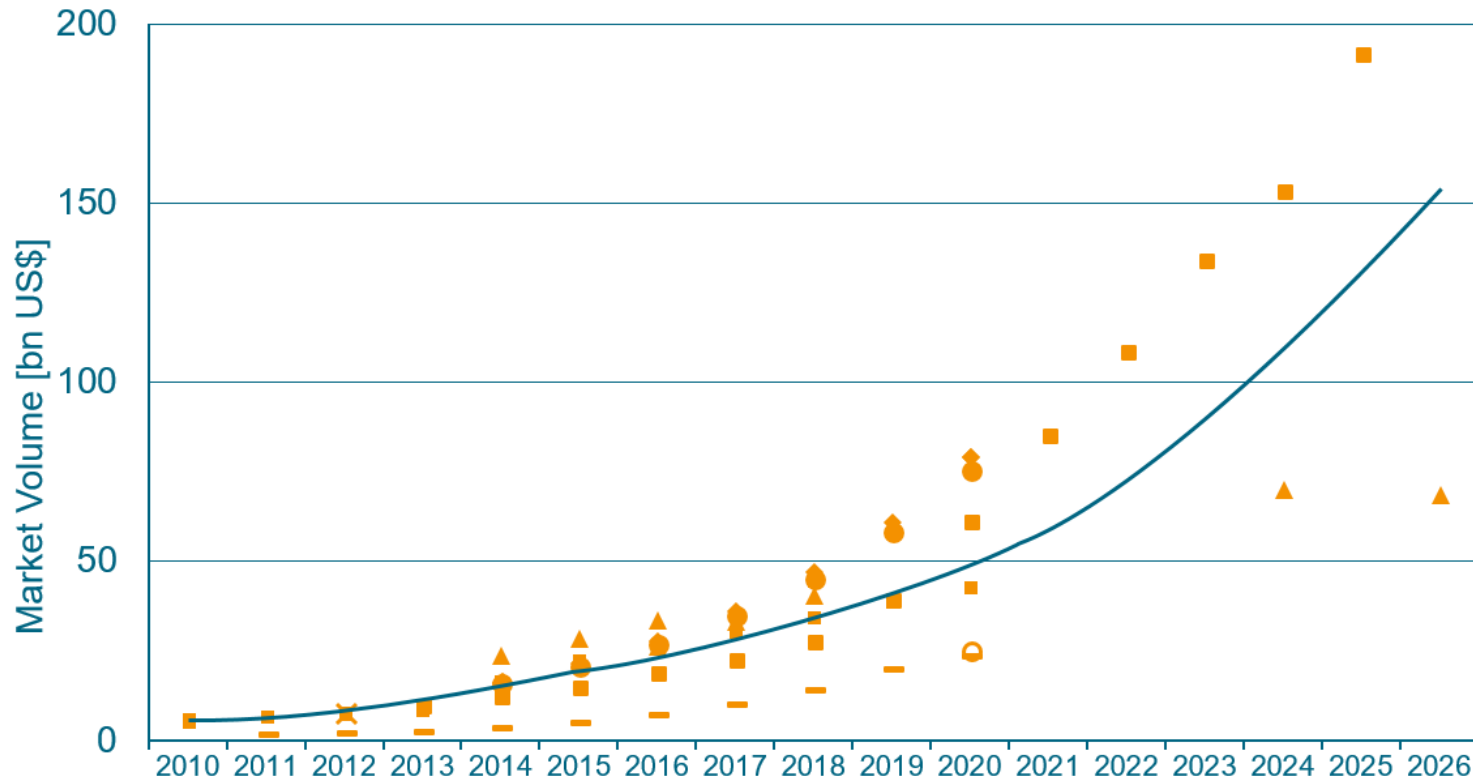
Interaction of Several Fields



- Automotive
- Consumer Electronics
- Healthcare
- Internet of Things
- Printing & Packaging
- Smart Buildings

Organic and Printed Electronics

A Multi-Billion \$ Market



© OE-A 2017

Sources: Allied Market Research, Displaybank, IDTechEx, Konica Minolta, Markets and Markets, Smithers Pira, Transparency Market Research

Organic electronics enables
new applications and opens
new markets

2019: 40 Bn US\$,
predominant by OLED
displays

Potential for a 150 Bn US \$
market within the next years
driven by lighting, displays,
OPV, sensors, logic,
memory / RFID,

OE-A Business Climate Survey on General Trends in Organic and Printed Electronics, March 2019

Most important targeted end-user industries:



20 %

Consumer Electronics



19 %

Automotive



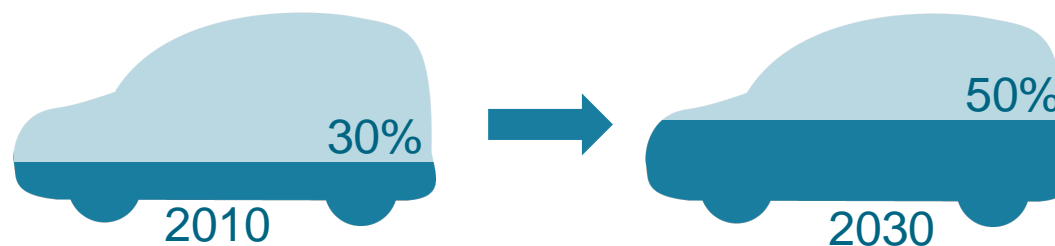
18 %

Medical &
Pharmaceutical

Electronics in Automotive Applications

Great potential for printed electronics components

“Potential applications include antennas, body parts, cockpits, loudspeakers, mounted structures and sensors. Flexible electronics can be incorporated into bumpers, head-up displays, instrument panels, seats, tires, windows and many other auto parts.”



Electronics content in car's total production costs

Global market of Automotive electronics and sub-applications

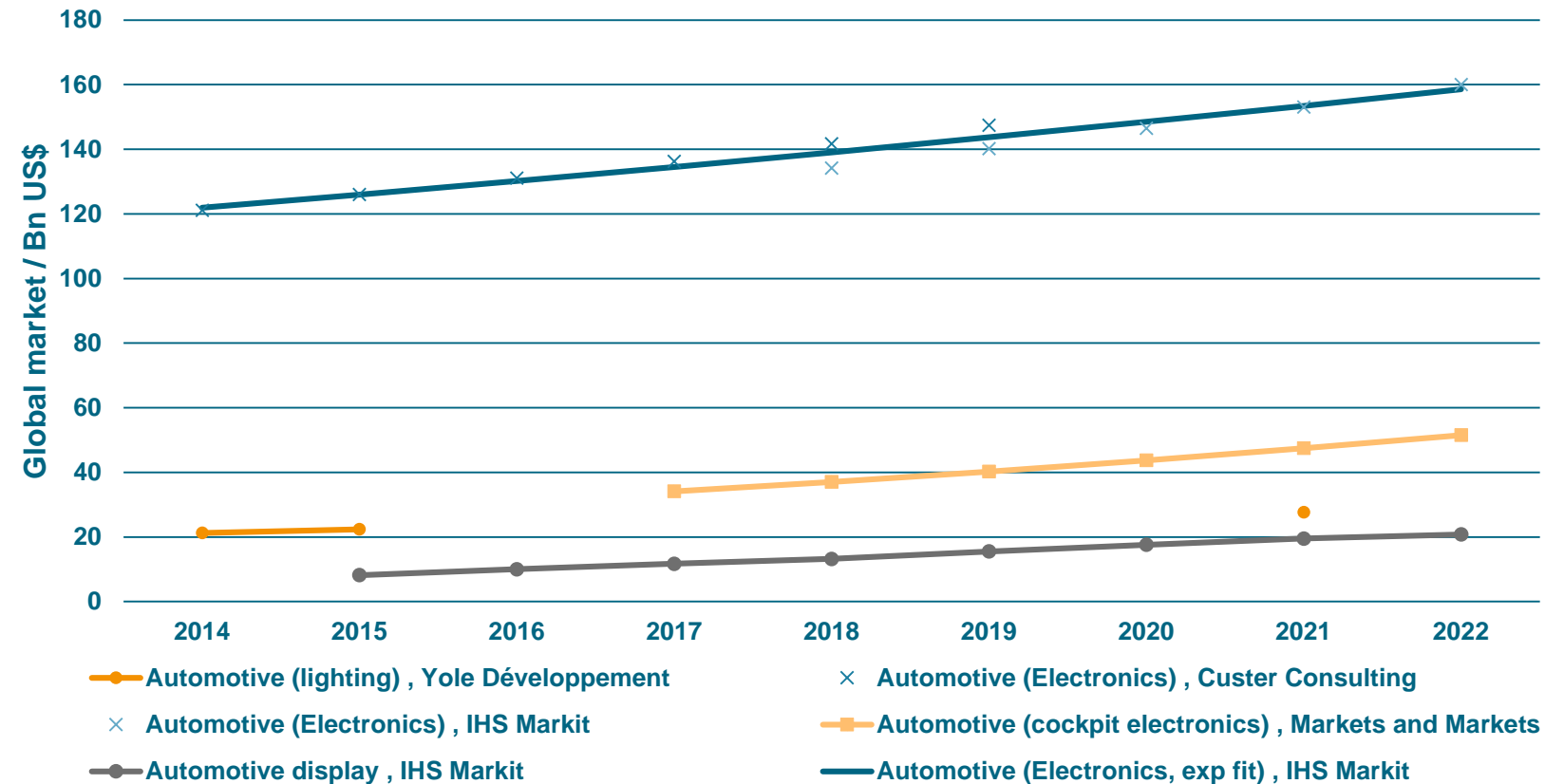


Mature markets

- » De-foggers
- » Seat heaters

Main market drivers

- » In-mold electronics
- » OLED technologies



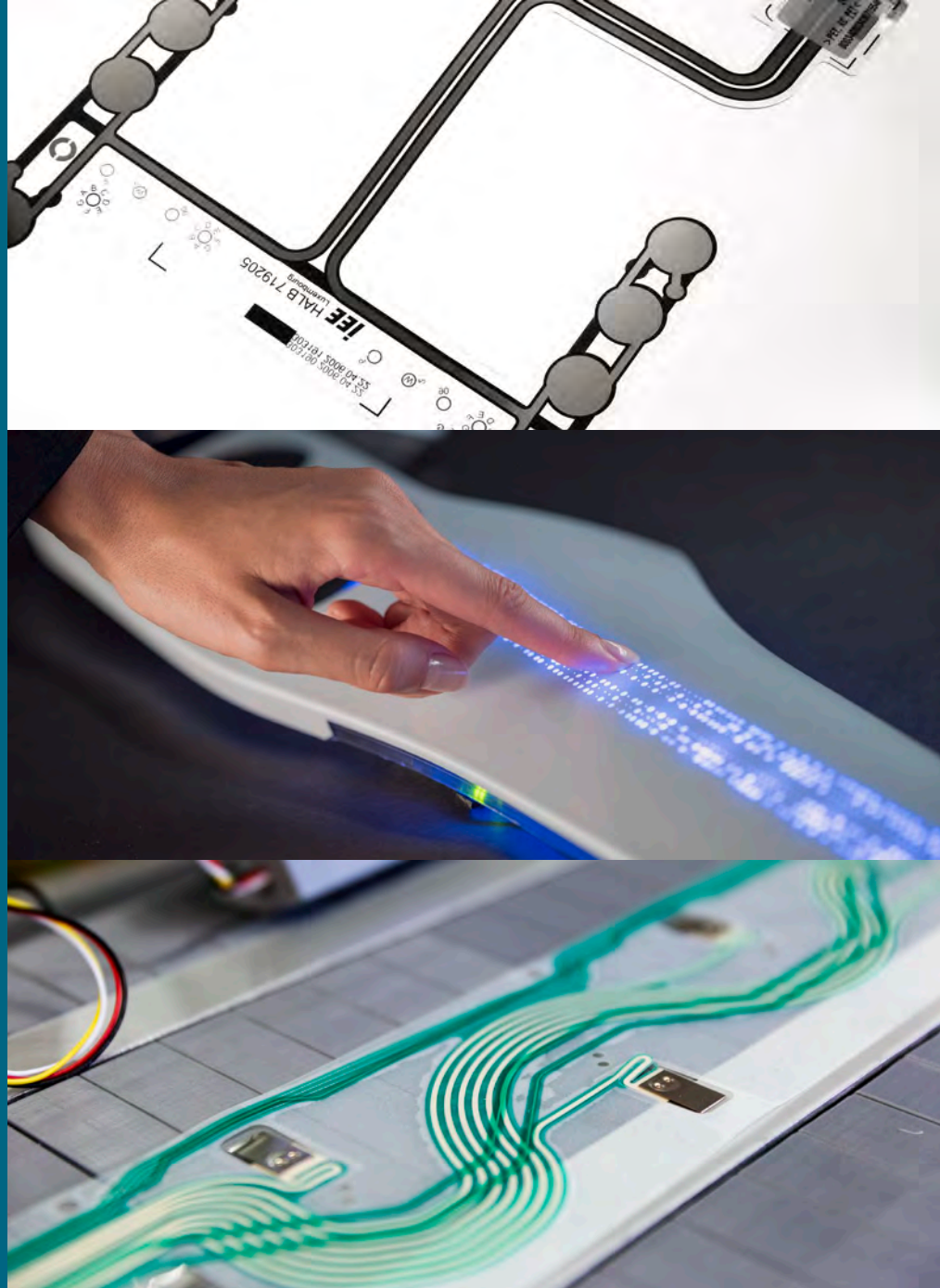
Printed Electronics for Automotive Sensors

Applications

- » Pressure sensors for seat occupant detection and classification
- » Touch-sensitive design elements
- » 3D & flexible integrated sensor applications for smart user interfaces & HMI
- » Battery management components

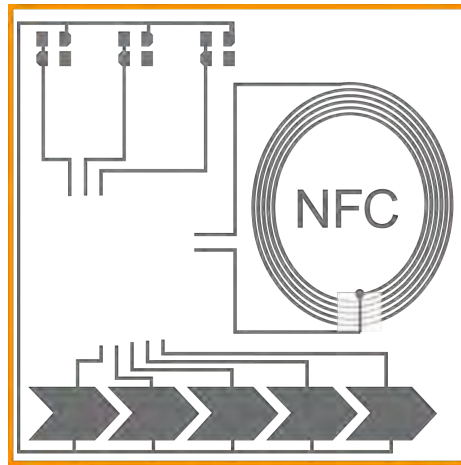
Increased

- » Safety
- » Functionality
- » Look-and-feel



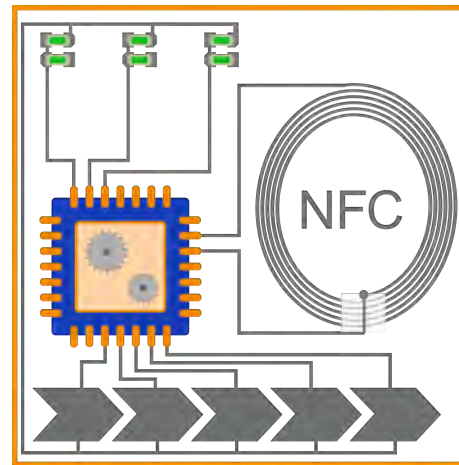
In-Mold-Electronics (IME)

- Reducing complexity



Step 1
Printing
circuit

(Touch sensors, cond. paths)

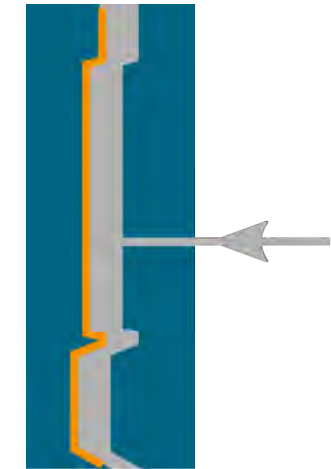


Step 2
Placing
components

(Chips, LEDs, OLEDs)



Step 3
Thermoforming



Step 4
Injection molding



OLED Displays



Current trends

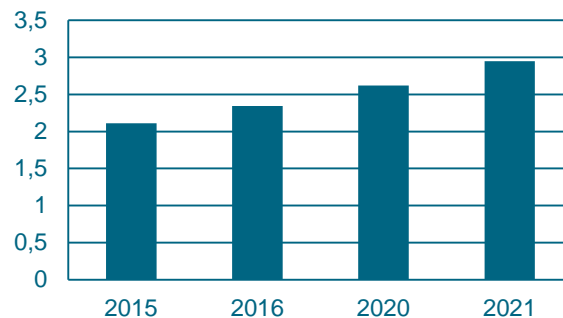
- » Ultra-thin, flexible, foldable for smartphones
- » Ink-jet printed OLED-Displays coming to the market in 2020 (by JOLED)
- » Less material waste
- » Pixel pitch down to 125 μm
- » 12" to 55" displays demonstrated

Printed Electronics in Consumer Electronics & Healthcare

Great Potential for Wearables



global wearable device sales
[bn units]



Smart headbands

- » Integrated sensors (e.g. EEG)

Smart glasses

- » OLED μ Displays

Smart textiles / clothing

- » Integrated sensors (e.g. ECG, temperature, motion, oximeter)
- » Integrated heating elements
- » Energy harvesting (e.g. solar cells, supercaps, batteries)

Smart earphones

- » Integrated sensors (e.g. temperature, accelerometer)

Smart necklace

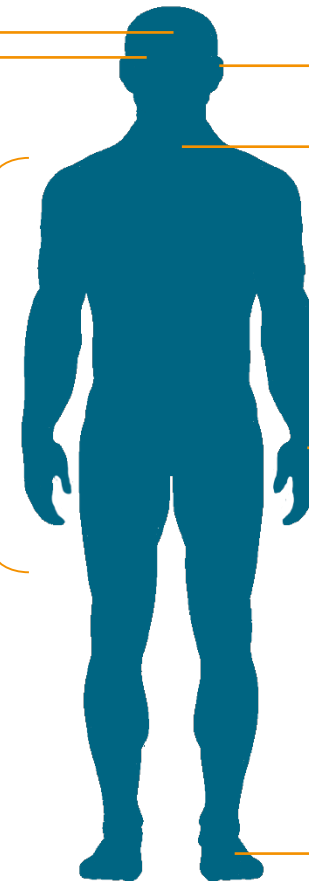
- » Integrated sensors (e.g. heartbeat, accelerometer)

Smart watches / wristbands

- » Displays
- » Integrated sensors (e.g. heartbeat, oximeter, glucose)

Smart shoes / socks

- » Integrated sensors (e.g. pressure)
- » Energy harvesting (e.g. electroactive polymers)



Wearables

Smart moisture management

- » Functionalized textile
- » Active pumping of moisture
- » Against equilibrium
- » Works in both directions

Product for the outdoor industry



HYDRO_BOT

ART M NAG N

will solve one of the biggest challenges in sports, work and
nothing: to obtain a moisture transport that actually matches
at rates at various climatic conditions and activity levels.

hydrobot.com for more information

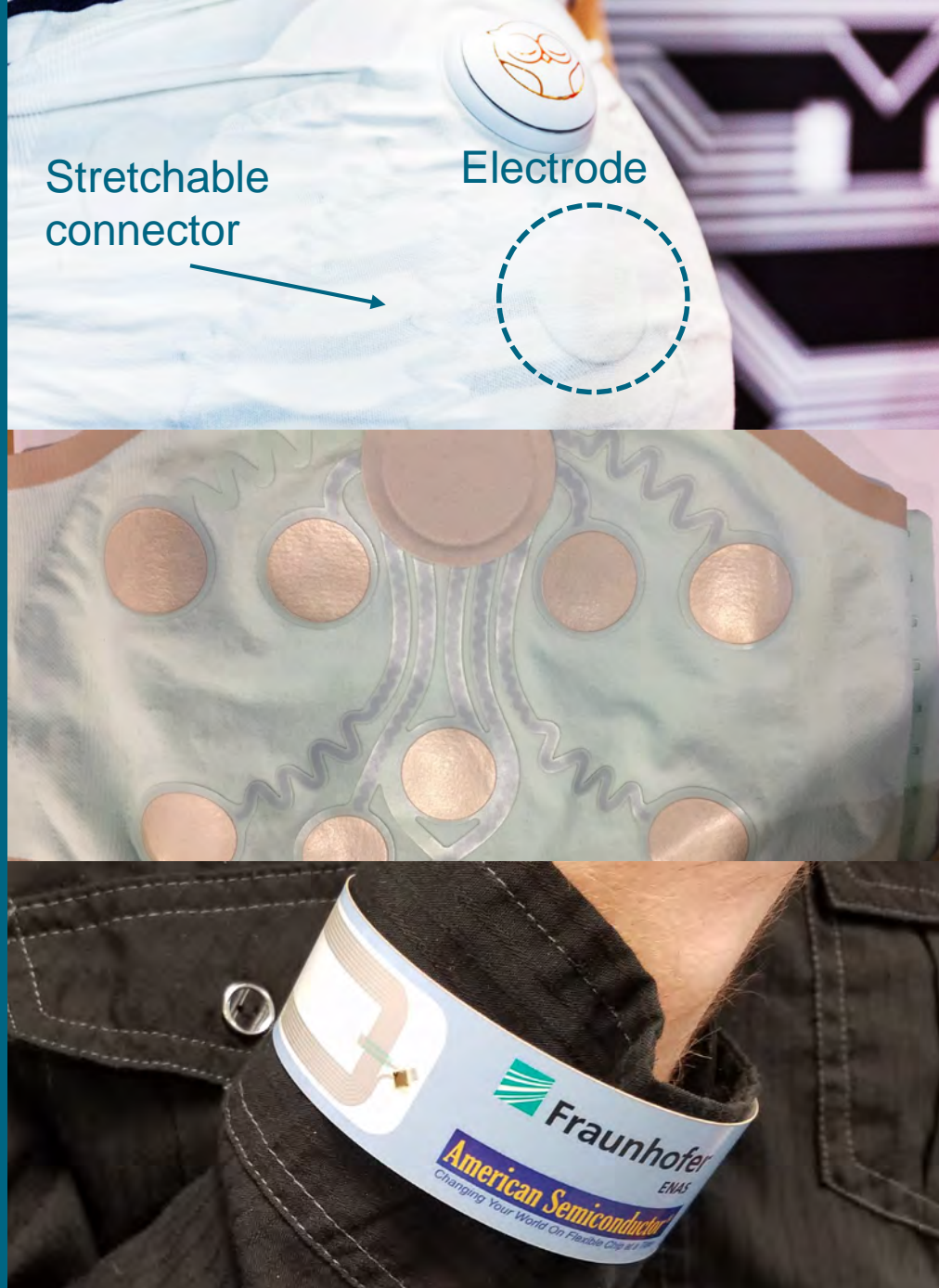
Printed Electronics in Healthcare Wearables

Applications

- » Wearable for detection of fetal heartbeat
 - 16 printed and stretchable electrodes
- » Temperature sensor with a flex-IC
 - easy read-out via NFC
 - Passive and active powering possible
 - Organic near-infrared sensors

Increased

- » Wellbeing
- » Comfort through stretchable connectors
- » Functionality



Smart Labels

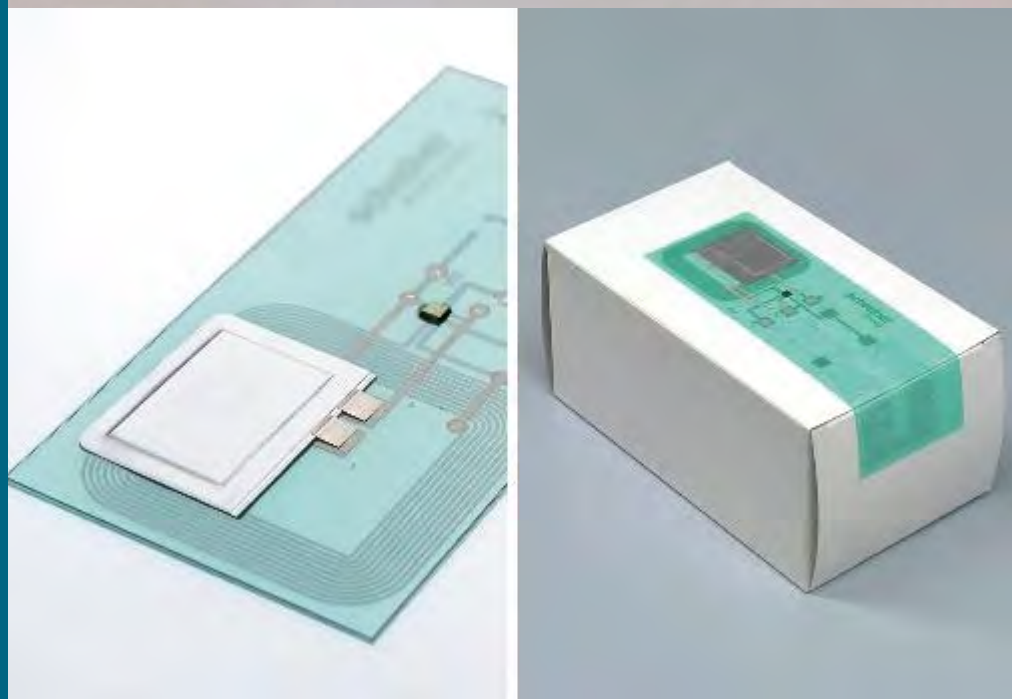
Sensor Platform

- » Continuous temperature measurement
- » First-opening sensing
- » NFC for communication
- » Location tracking (via smartphone)

Targeting

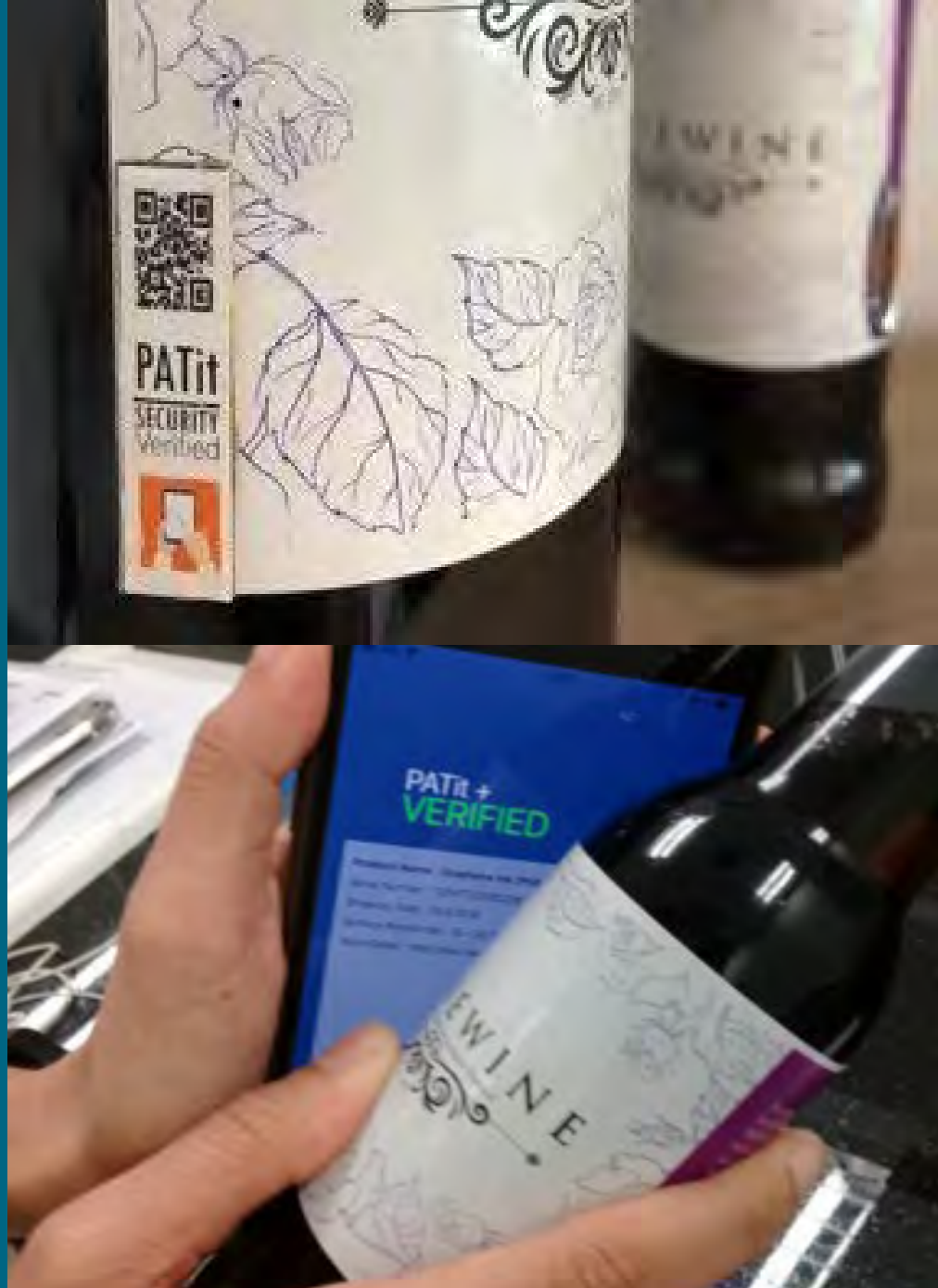
- » Pharma packaging, e.g. for vaccines

**Launched at LOPEC 2017 by Schreiner
PrinTronics**



PATit - Anticounterfitting Coding System

- » Graphene based ink
- » Transparent ink changes capacity in reader device
- » Pattern is recognized as a unique multitouch
- » Any smartphone can be used to authenticate product





Luminous Packaging



OLED label

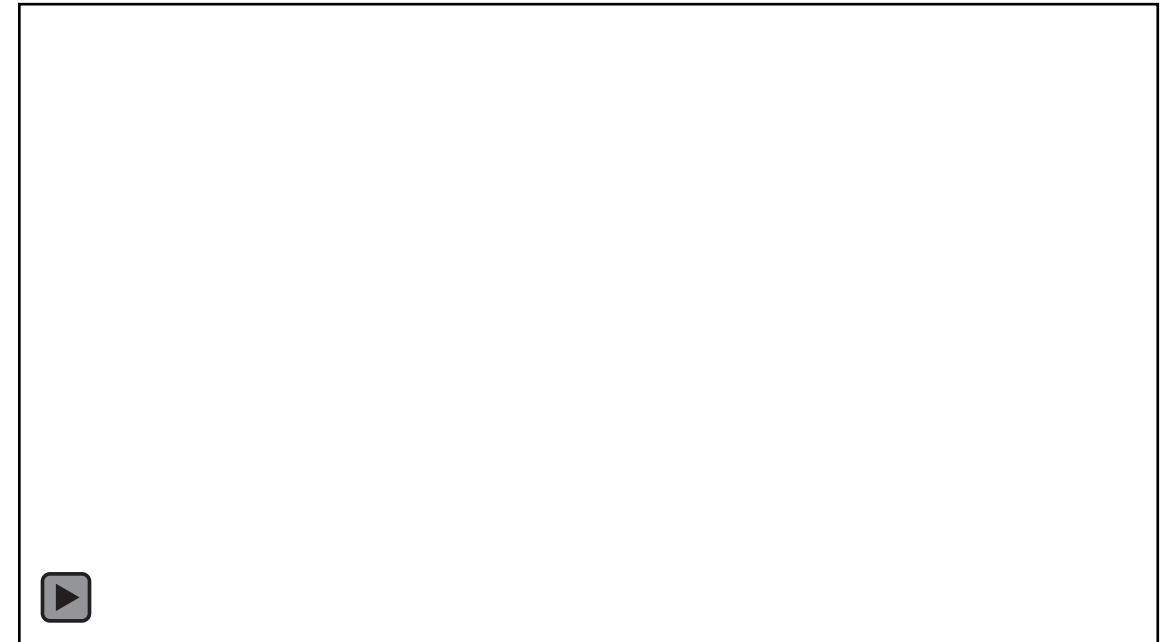
- » Flexible white OLED
- » Flexible battery integrated
- » Blinking animation

Produced by Karl Knauer KG, Germany

www.karlknauer.com

Demonstrator at LOPEC 2019

- » Printed battery
- » Pinned circuit
- » Regular LEDs
- » Resistive switch
- » Coordinated by Prof. Gunter Hübner, HdM








OE-A Roadmap, 7th Edition Overview

Forecast for Market Entry of OE Applications

Short, medium and long term forecasts for application clusters

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

OE-A Roadmap for Organic and Printed Electronics Applications 2017

	Existing 2017	Short Term 2018-2020	Medium Term 2021-2023	Long Term 2024+	
	Rigid white OLED modules; rigid red OLEDs for automotive applications	Flexible OLEDs (color); flexible OLEDs (white)	Transparent OLEDs; flexible red OLED for automotive applications	3D OLEDs; dynamic OLED signage (segmented); long stripes; OLED in general lighting	OLED Lighting
OPV	Portable OPV chargers; personal electronics power supply	Large area OPV foil; OPV objects; opaque OPV for building integration	OPV integrated in building products	OPV in packaging; energy harvesting combined with storage	
	Curved OLED displays; EPD shelf-edge labels; EPD secondary displays on phones; displays for wearables	EPD wrist band; transparent displays; conformable OLCD; enhanced display integration in wearables	Curved displays for automotive interior; integration into clothing; white goods displays	Wallpaper displays; displays in everyday objects; foldable displays	Flexible & OLED Displays
Electronics & Components	Printed devices: memory, RFID antenna, primary battery, active backplane; sensors: glucose, touch, temperature, humidity	Printed mobile communication devices based on antennas, light sensor; stretchable conductors / resistors; 3D touch sensors	Printed lithium ion battery; printed super caps; active touch & gesture sensors	Printed complex logic; 3D & large area flexible electronics	
	Glucose in-body sensing; pressure sensor arrays; NFC labels; hybrid RFID; HMI (sensors)	Smart labels (discrete); HMI (embedded electronics & displays)	Human monitoring patches (single parameter, point of care, on-skin); disposable & quantitative sensors for food safety; biomedical sensors	Fully printed RFID / NFC label; ambient intelligence (connected); sensors for security (explosives)	Integrated Smart Systems

Existing 2017	Short Term 2018-2020	Medium Term 2021-2023	Long Term 2024+
Printed devices: memory, RFID antenna, primary battery, active backplane; sensors: glucose, touch, tempera- ture, humidity	Printed mobile communication devices based on antennas; light sensor; stretchable conductors / resistors; 3D touch sensors	Printed lithium ion battery; printed super caps; active touch & gesture sensors	Printed complex logic; 3D & large area flexible electronics

- » Parts & devices that are used in other applications (“supplier”)
- » Active OPE devices not yet established in the market progress in performance and in analog circuitry
- » Printed batteries & supercapacitors are emerging

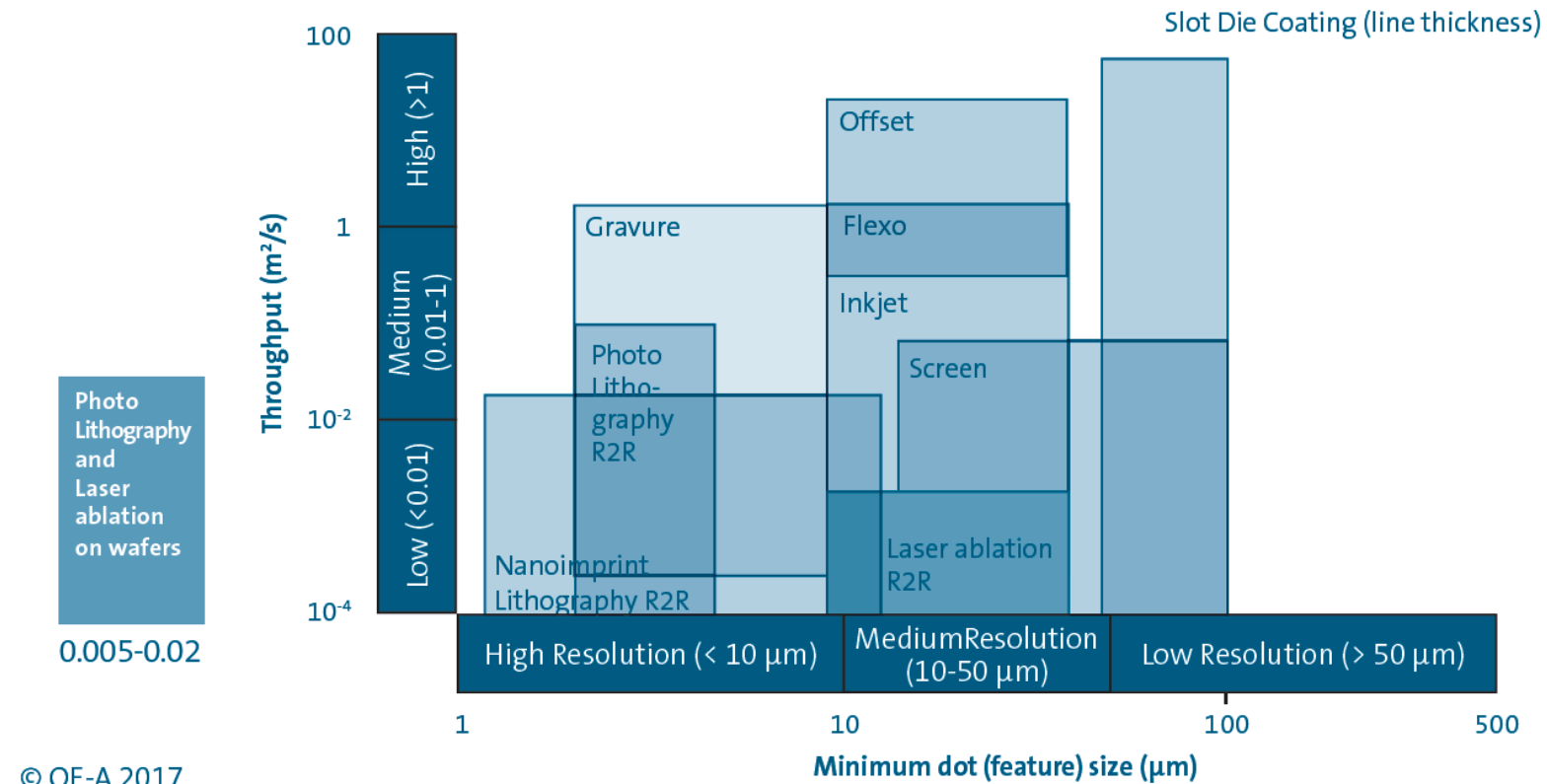




Existing 2017	Short Term 2018-2020	Medium Term 2021-2023	Long Term 2024+
Glucose in-body sensing; pressure sensor arrays; NFC labels; hybrid RFID; HMI (sensors)	Smart labels (discrete); HMI (embedded electronics & displays)	Human monitoring patches (single parameter, point of care, on-skin); disposable & quantitative sensors for food safety; biomedical sensors	Fully printed RFID / NFC label; ambient intelligence (connected); sensors for security (explosives)
<ul style="list-style-type: none">» Increasing importance of Internet of Things (IoT), wearable health and wellbeing applications» Creating added value by integration of multiple functionalities & technologies» Hybrid systems important enabler			

Technology Clusters

Printing & Patterning



Technology Clusters

Printing, Coating and Patterning Techniques

	Analog (permanent printing master)	Digital (non-permanent printing master)
R & D (only used in R & D)	reverse offset printing	micro plasma printing
Commercial (used in production)	flexographic printing rotogravure printing offset printing screen printing pad transfer printing hot stamping slot-die coating photolithography nanoimprint lithography	inkjet printing xerography aerosol jet printing laser ablation / processing laser transfer syringe deposition

OE-A Roadmap, 7th Edition



Organic and printed electronics solutions finding their way into major industry sectors

- » Indicator of growing maturity of printed electronics
- » Some solutions already commercial on significant scale
- » Move from “technology push” to “market pull”
- » Many OPE applications will involve hybrid systems

Automotive



Consumer Electronics



Healthcare



Internet of Things



Printing & Packaging



Smart Buildings



Get connected to the international OE-A network!



ICFPE 2019

- » October 23-25, 2019, Taipei (TW)
OE-A is partner of ICFPE and organizer of a conference session.
- » Joint Pavilion at TPCA Show



OE-A Meeting Europe

- » October 28-29, 2019, Frankfurt (DE)
Hosted by VDMA
Special Topic: "Expanding Dimensions: 3D Structural Electronics"



OE-A networking event, Santa Clara, US

- » November 19, 2019, evening
(day before PE USA)

LOPEC 2020, March 24-26

ICM Munich, Germany

**The central marketplace for Organic and Printed Electronics,
in cooperation with Messe Munich**

- » 2,700+ attendees
- » 160+ international exhibitors
- » 200+ presentations

Exhibition

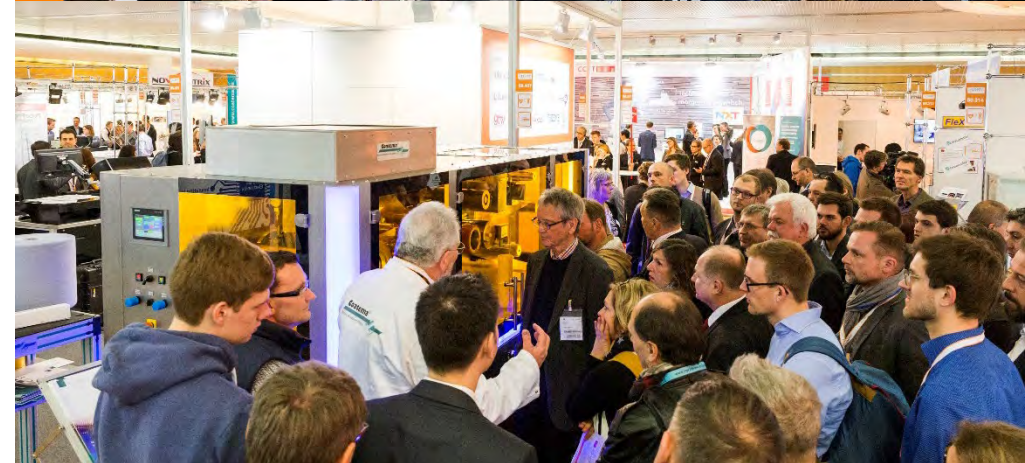
- » Largest industry exhibition in the field
- » On-site production on demo line

Conference

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

10% discount for OE-A members

Call for Papers open until October 25, 2019



www.lopec.com



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OE-A (Organic and Printed Electronics Association) – A working group within VDMA



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