

Anwendungspotentiale gedruckter flexibler und 3D-geformter Elektronik

2022-10

Wolfgang Mildner



Profile

- ▶ 15y of competence in Printed Electronics
- ▶ 10y of competence in 3D structural electronics



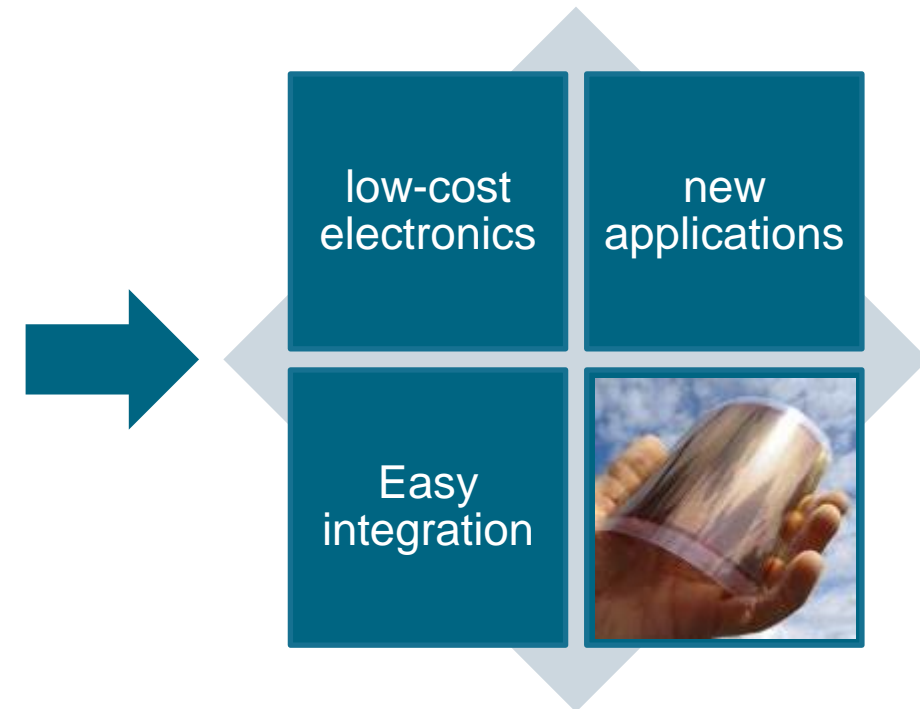
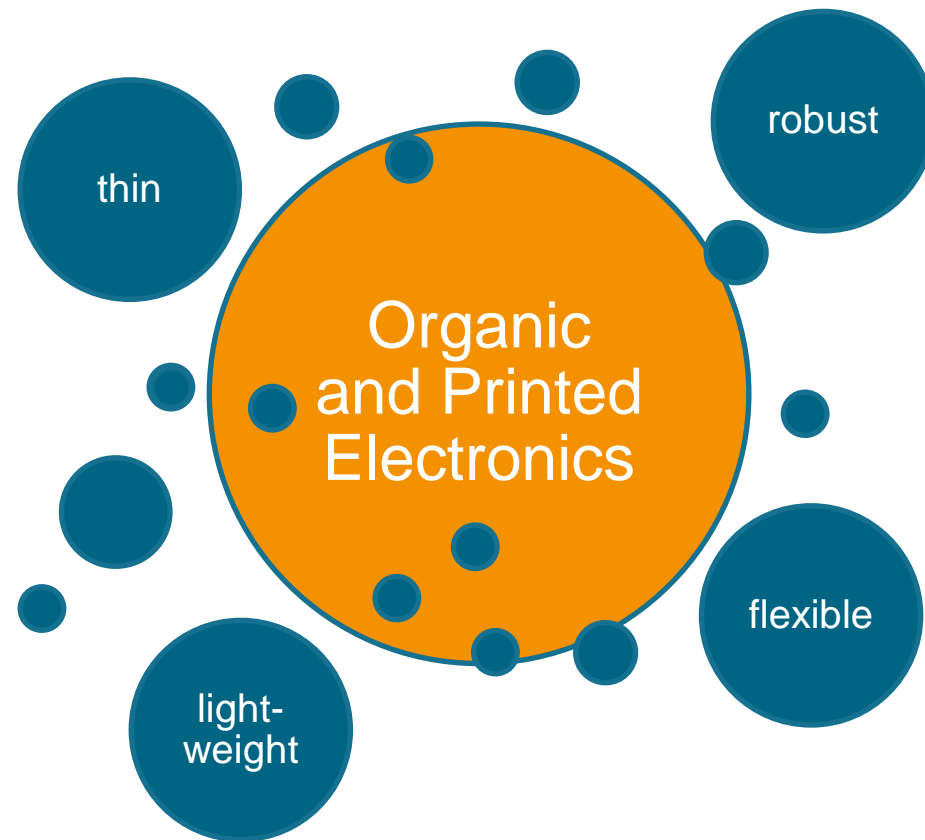
- ▶ Seit 2020
ZIM Project HIDRONIK
„Hybride Systeme auf Basis
gedruckter Elektronik“

Projects

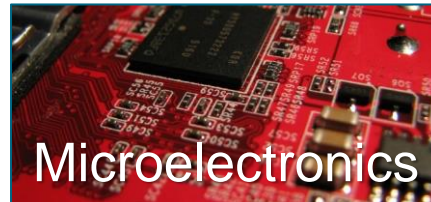
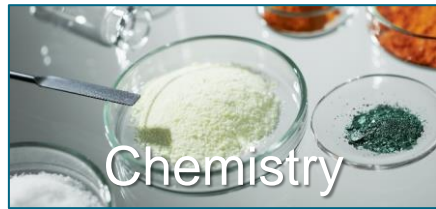
- ▶ Enable innovation and create value with
- ▶ New technologies (Printed electronics)
- ▶ New workflow (3d integration)

Organic and Printed Electronics

Ambient intelligence – Electronics everywhere



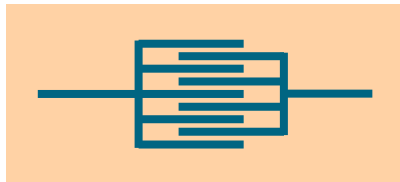
Interaction of Several Fields



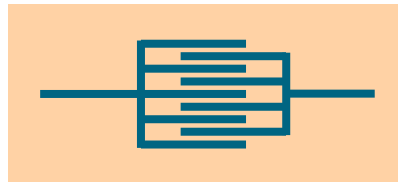
- Automotive
- Consumer Electronics
- Healthcare
- Internet of Things
- Printing & Packaging
- Smart Buildings



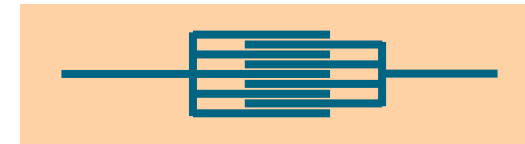
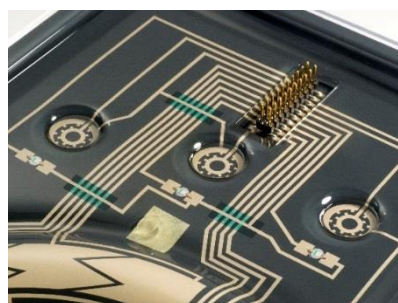
Form options of Printed Electronics



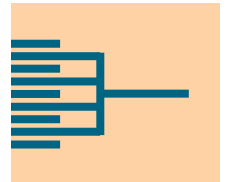
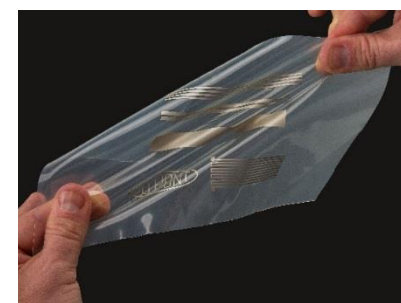
rigid / flexible



conformal



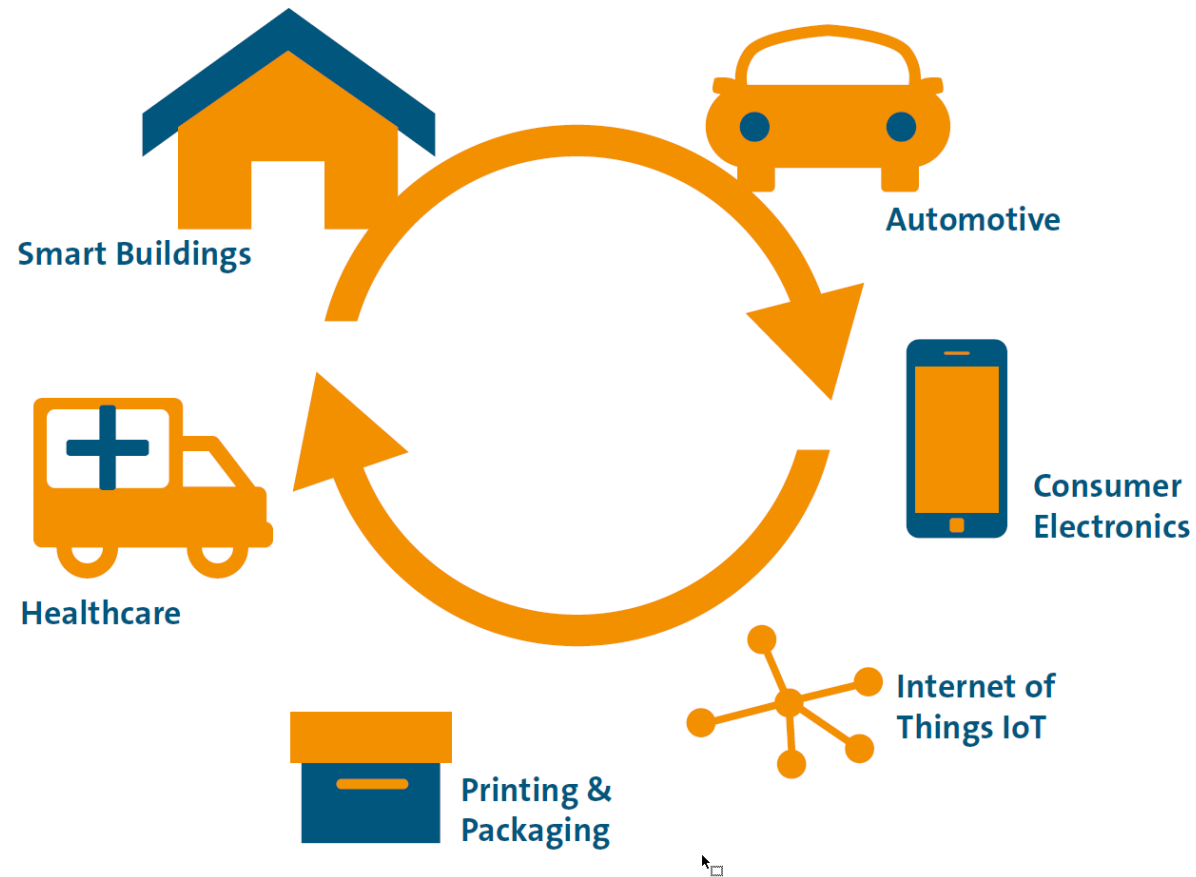
stretchable



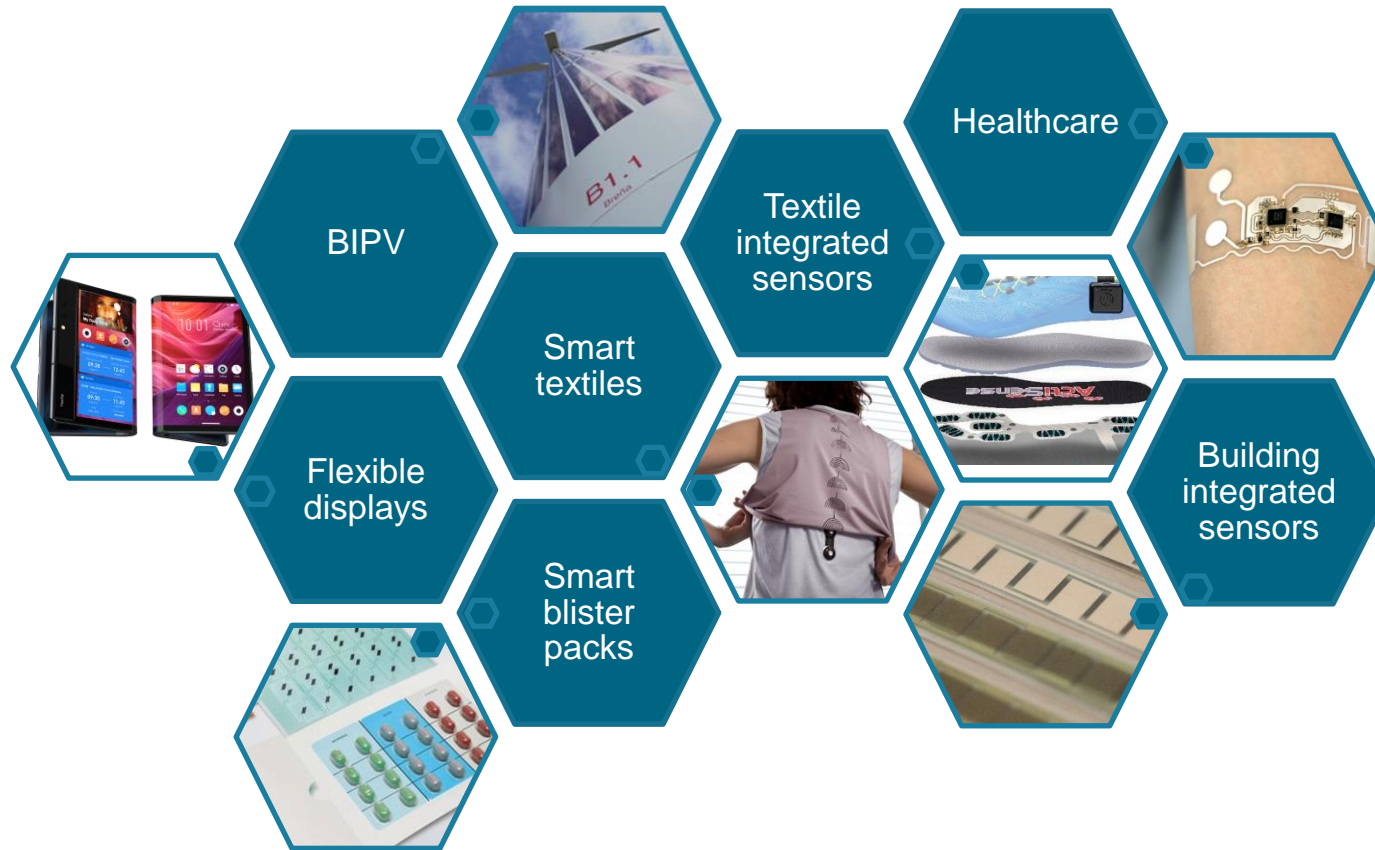
bendable



Printed Electronics in everyday life



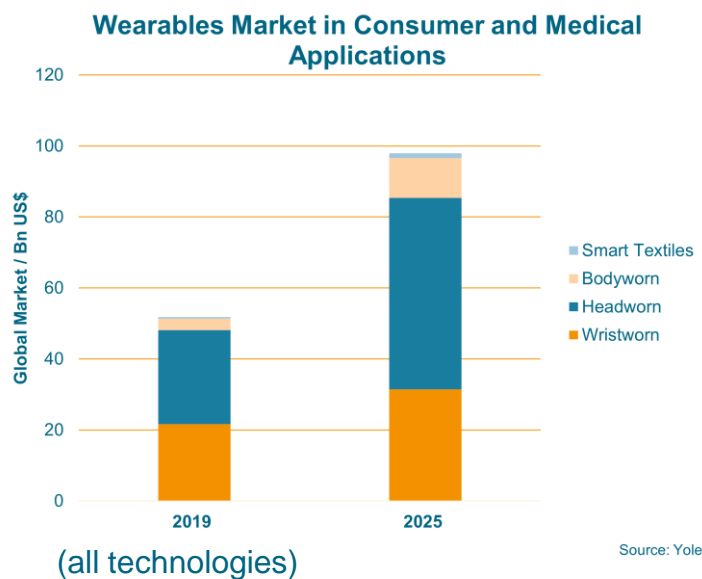
Printed Electronics for Smart Living



- » Technological advances and aging society lead to growth of the healthcare and wellbeing industry
- » The role of OPE in this sector is expected to grow further in the coming years

Printed Electronics in Consumer Electronics & Healthcare

Great Potential for Wearables



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

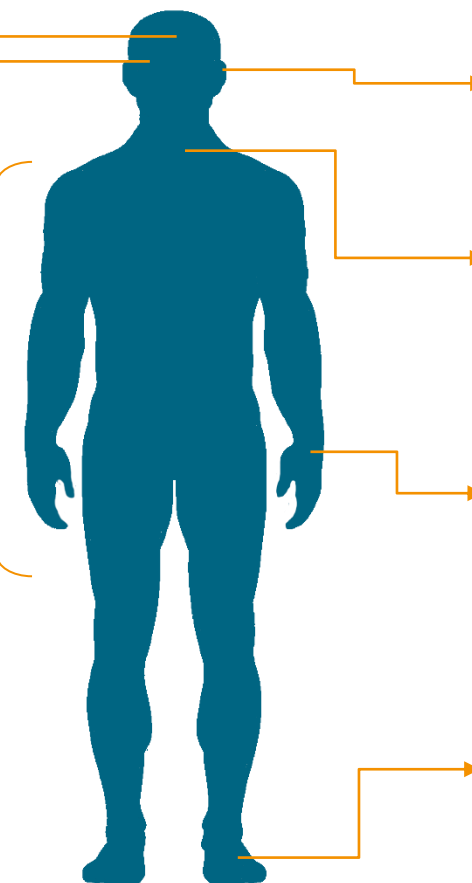
- » Integrated sensors (e.g. heartbeat, accelerometer)

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)



Printed Electronics in Healthcare and Wellbeing

Applications include

- » Smart textiles to control breathing rhythm
- » Heated jackets
- » Smart soles to measure gait and pressure
- » Smart face masks



Printed Electronics in Healthcare and Wellbeing

Applications include

- » Smart patches to monitor
 - ECG
 - Bio-impedance
 - Acceleration
 - Posture
- » Smart blister packs
- » Contraction sensors
- » Sensor mats for monitoring of motion and vital parameters



Printed Electronics for Sustainability

Applications

- » RFID tags for digital tyre tracking enabling safe and responsible disposal of tyres
- » RFID/NFC tags for enhanced recycling of plastic waste
- » Smart labels for food waste reduction
- » OPV for sustainable energy generation



OPV Anwendungen



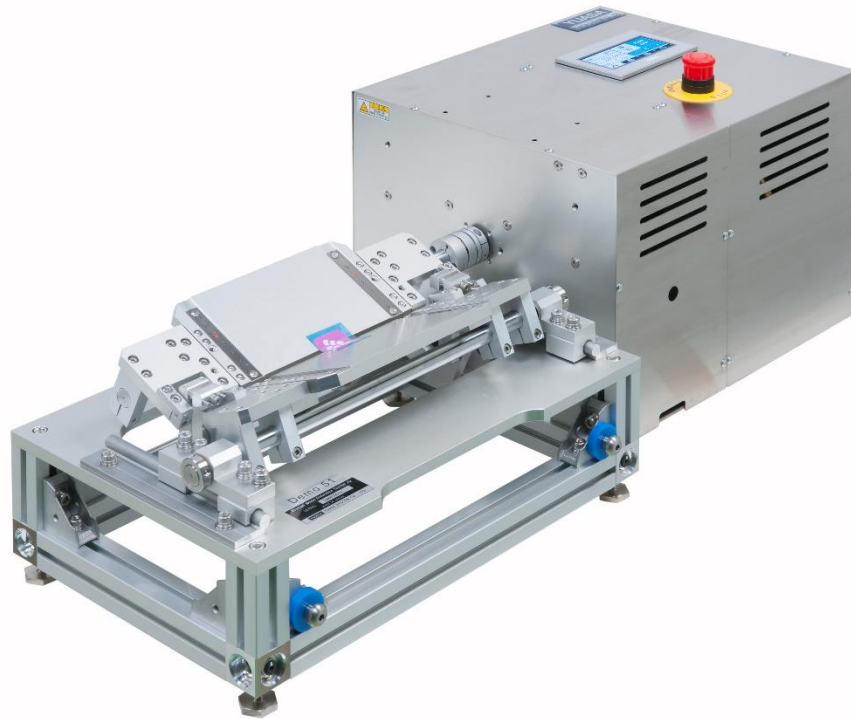
Pictures: Heliatek



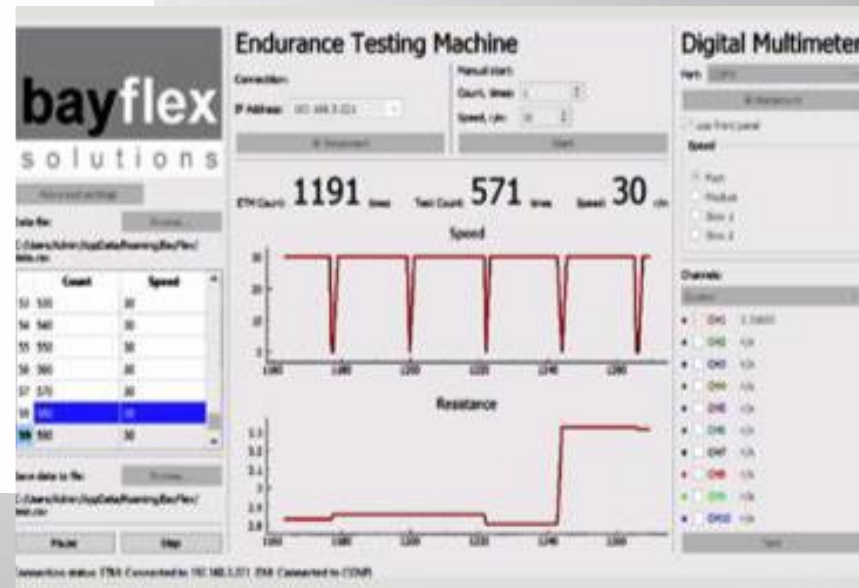
Pictures: ASCA: Novartis Pavillon

Quality Control of flexible 3D
electronics is a key competence

New Methodes for Quality Control

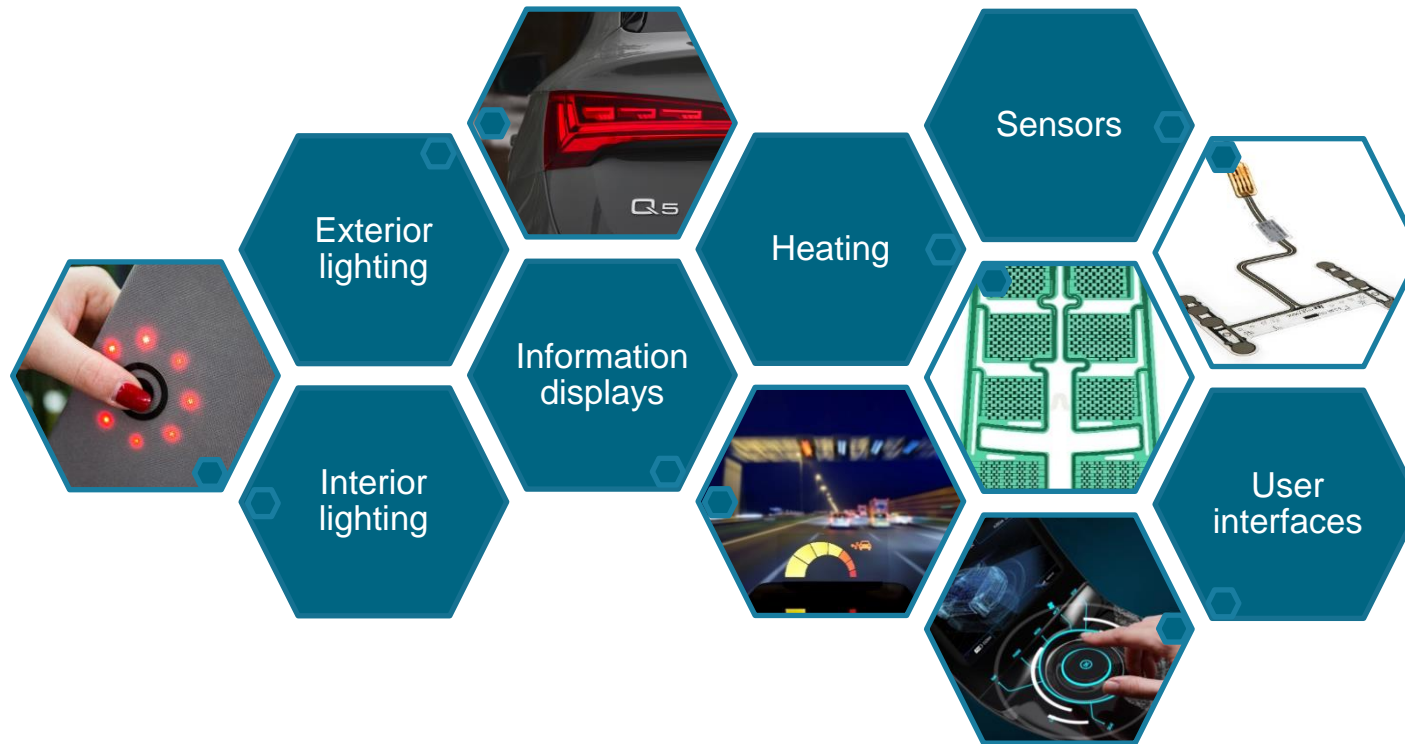


- ▶ Bending, Folding needs to be tested mechanically
- ▶ Data Acquisition allows analysis



Picture: courtesy of Yuasa, Bayflextechnologies

Printed Electronics Applications in Automotive



- » Automotive industry as one of the main end-user sectors
- » Organic and printed electronics (OPE) as an enabler for new applications
- » Market driven by transition to electric vehicles and autonomous driving
- » Overall market expected to grow to 12.7 bn US\$ in 2031

Automotive Applications OLED Lighting and Displays

Applications

- » Tail lights
- » Interior/Human-centric lighting
- » Center console as display
- » Wind-shield integrated head-up displays
- » Conformable displays
- » OLED displays as side mirror replacement

Benefits

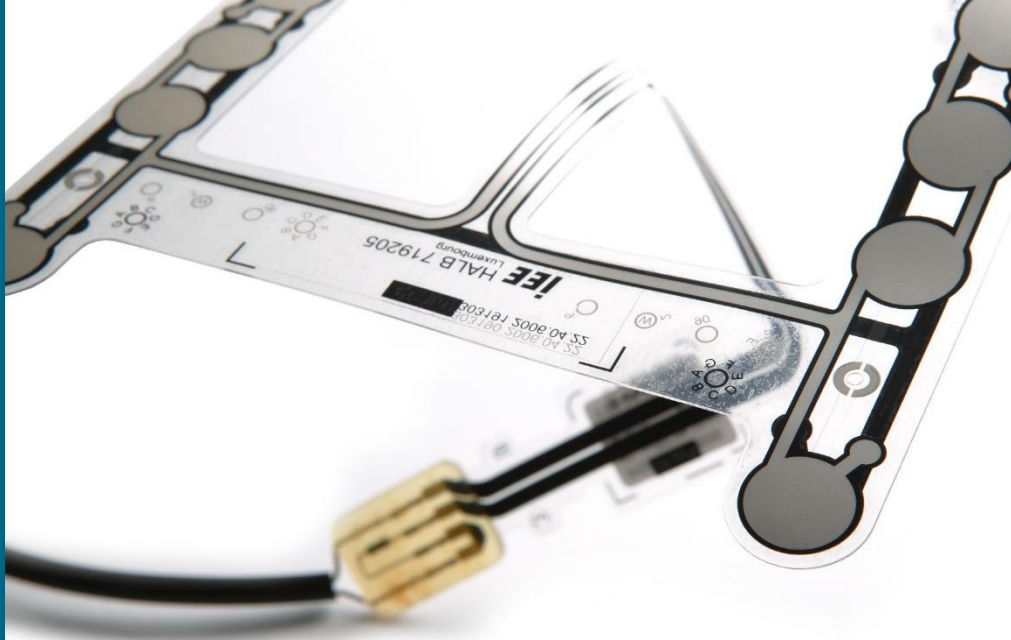
- » Freedom of design
- » Lightweight functional integration



Automotive Applications Sensors

Applications

- » Seat occupancy detection
- » Touch surfaces for HMI
- » Hands off detection
- » Radar antennas



LOPEC – largest event on printed, flexible electronics

- Facts & Figures



Performance figures for LOPEC 2022

- 156 exhibitors from 23 countries
- 2,000 participants, over half of them international guests
- 200 conference presentations from 25 countries
- 98 percent of participants feel that LOPEC's importance is stable and/or growing

Highlights

- Roundtable Women in PE
- Introductory talks and tours
- State of the art – innovation showcase



LOPEC 2023

SAVE THE DATE

FEBRUARY 28 – MARCH 02, 2023

LOPEC.COM

International Exhibition
and Conference for the
Printed Electronics Industry

Exhibition: 01-02 March, 2023
Conference: 28 February - 02 March, 2023
Messe München, Germany



ZIM FuE-Netzwerk „Hybride Systeme mit gedruckter Elektronik (Hidronik)“

Wolfgang Mildner, Dr. Thomas Kunz

 metropolregion **nürnberg**
FORUM KLIMASCHUTZ UND
NACHHALTIGE ENTWICKLUNG

Motivation

- Dünne, flexible und leichte Elektronikprodukte (-> Integrierbarkeit)
- Additive Fertigung (wenig Materialverbrauch, skalierbare Produktion)
- Erhöhter Bedarf u.a. durch Internet of Things (IoT)
- Durch hybride Konzepte Vorteile aus gedruckter und konventioneller Elektronik



Dünnschicht-Elektrolyt-Sensor zur Schweißanalyse
(Quelle: M. Jank, Fraunhofer IISB)

Start: 1. Juli 2020, Phase 1 bis Juni 2021
Verlängerung (Phase 2) bis Juni 2023

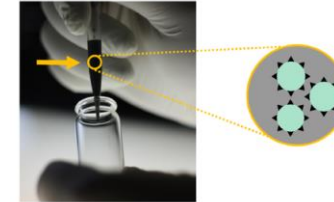
Schwerpunkte für Hidronik z.B.:



HIDRONIK
Hybride Systeme mit gedruckter Elektronik

- Verbindungstechnologie von etablierter mit gedruckter Elektronik
- Software/CAD für MID- und Druckverfahren
- Kombination von etablierten Fertigungsverfahren mit gedruckter Elektronik
- Integration von Bauelementen in mechatronische Komponenten
- Innovative Prozesskombinationen, inline Kontrolle
- Innovative Produktkomponenten
- Untersuchung des Langzeitverhaltens

Silbernanopartikeltinte:

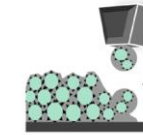


Dispersion aus:

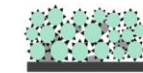
- Silbernanopartikel
- ◀ Organisches Coating
- Lösungsmittel u. Additive

Prozess:

1. Drucken



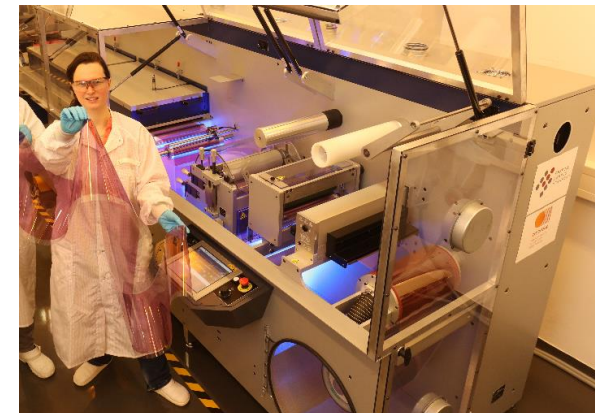
2. Trocknen



3. Verdichten und Sintern



Herstellung von leitfähigen Strukturen auf Kunststoff
(Quelle: M. Reichenberger, TH Nürnberg)



Dünnes, flexibles OPV-Modul hergestellt mittels R2R-Druckprozessen. (Quelle: H.-J. Egelhaaf, ZAE Bayern)

- **Neotech AMT GmbH** (5-achsige Drucksysteme für gedruckte Elektronik)
- **GSB-Wahl GmbH** (leitfähige Tinten)
- **Automatic Research GmbH** (Großflächiger Druck organischer Elektronik & Messtechnik)
- **SEHO Systems GmbH** (Lötprozesse und automatische Fertigungslinien)
- **Enerthing GmbH** (Gedruckte OPV für Indoor-IOT Applikationen)
- **Metawell GmbH** (Herstellung von Leichtbaukomponenten)
- **RAS AG** (Herstellung von Nanosilbermaterialien und Tinten)
- **Ph2: IE Lab**
- **Ph2: InfiniteFlex**
- **Ph2: quadraton**
- **Ph2: Kundisch (assoziiierter Partner)**

- **Fraunhofer IISB** (Integration gedruckte und konv. Elektronik, IoT)
- **TH Nürnberg**, Kompetenzzentrum Analytik, Nano- und Materialtechnik (Umformen in 3D-Strukturen)
- **FAU: FAPS**, Technische Elektronik (3-D MID), Solarfabrik der Zukunft (Gedruckte organische Photovoltaik)
- **Hochschule Hof** (Elektrisch funktionalisierte Kunststoffbauteile)
- **Ph2: INM – Leibniz-Institut** für Neue Materialien
- **Ph2: Friedrich-Schiller-Universität Jena**

Noch weitere Partner sind/werden angefragt.

Conclusion

- ▶ printed flexible electronics and 3D printed electronics enable new business opportunities for flexible and conformable products
- ▶ 3D Integration allows **3D structural electronics**
- ▶ Commercial products are available or will be available soon
- ▶ Many process options are available
- ▶ The solution is based on application requirements and experience
- ▶ Cooperation along the value chain is key for success

Contact details



Wolfgang Mildner

Wolfgang.mildner@mswtech.de

www.mswtech.de
Stein, Germany



 **@wmildner**

Member of:



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

-  ▶ Join the OE-A group on LinkedIn! www.linkedin.com
-  ▶ @OEOnline
- ▶ www.oe-a.org



3D-MID 3D Mechatronics integrated Devices

- ▶ www.3D-mid.de



Thank you
Thank you
for your attention!