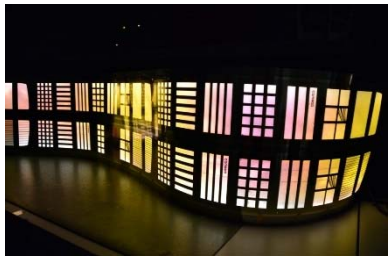
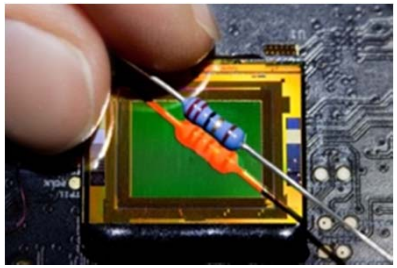
Organic Electronics and Organic Photodiodes

Fraunhofer Institute for Electron Beam, Plasma Technology and COMEDD FEP





VERSION 2014-03-17

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Core Competencies

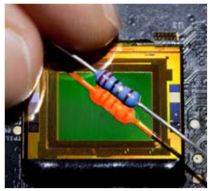
ELECTRON BEAM TECHNOLOGY

PLASMA-ACTIVATED HIGH-RATE DEPOSITION

SPUTTERING TECHNOLOGY

HIGH-RATE PECVD

TECHNOLOGIES FOR ORGANIC ELECTRONICS



IC AND SYSTEM DESIGN

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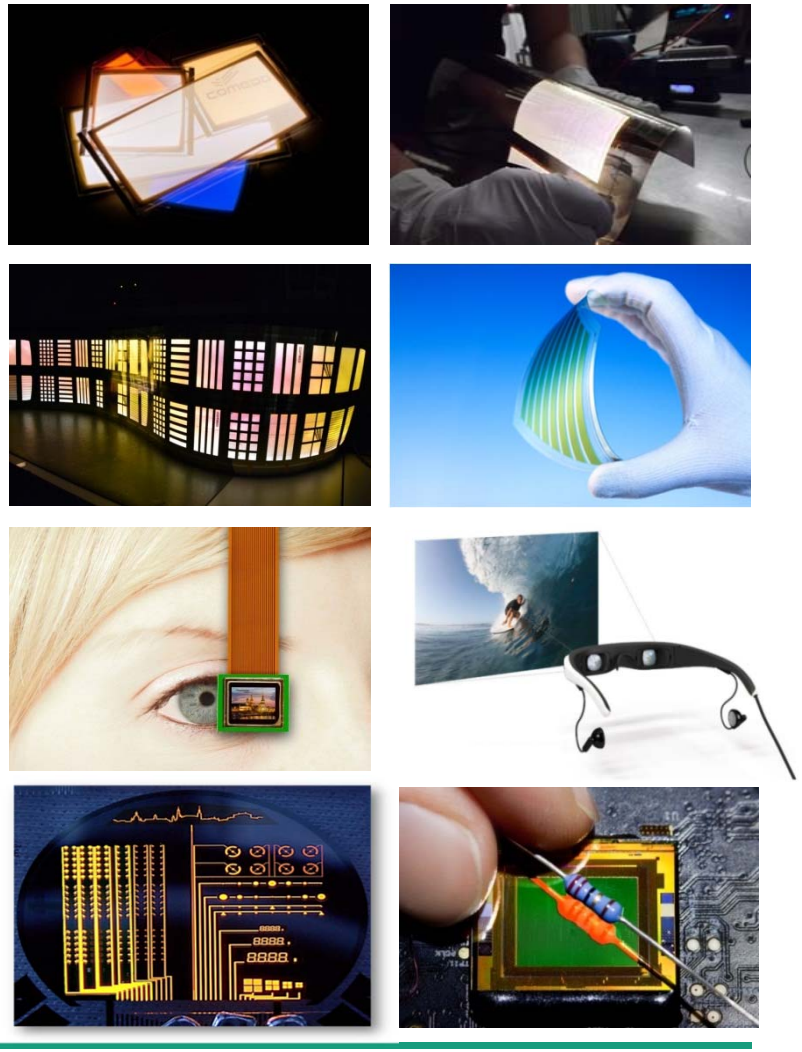
Organic-electronic Devices

Customer specific R&D on novel device concepts and manufacturing methods for Organic Electronics (mostly small molecule)

- **Flexible Organic Electronics**
  - Manufacturing- and integration- technologies for novel **large area** (OLED-) lighting solutions
  - Flexible foil substrates (esp. Roll-to-Roll-technology) for flexible applications
  - Organic photovoltaics (OPV) for org. solar cells
- **Microdisplays & Sensors**
  - OLED-on-Silicon technol. & device development
  - Bi-directional **micro**display for e.g. data glasses
  - Microstructured OLED for e.g. microscopes
  - Organic photodiodes (OPD, OTFT)
  - Customer specific R&D, product-development and prototyping / pilot-fabrication



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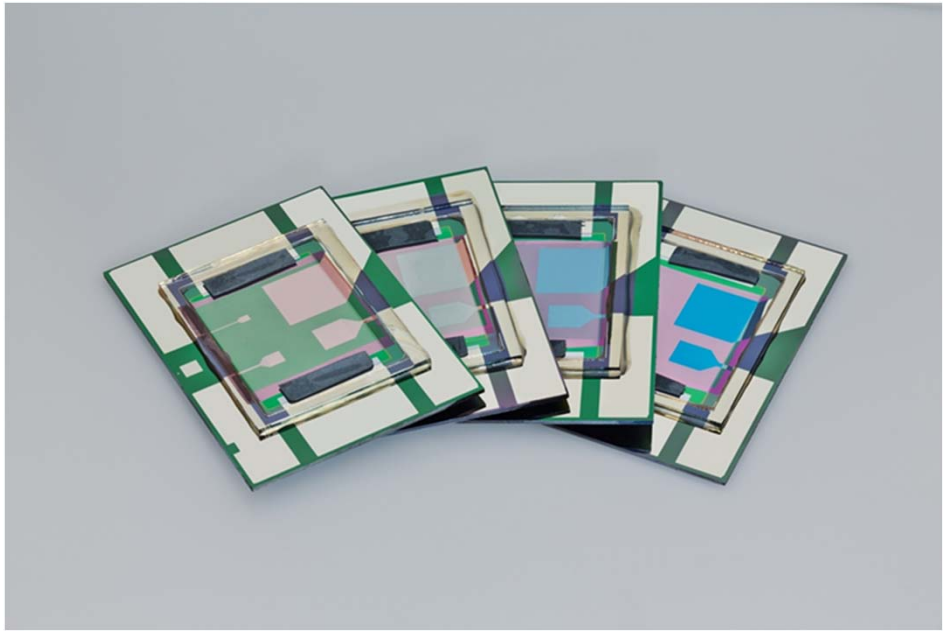
Highlight: Organic Photodiodes (OPD)



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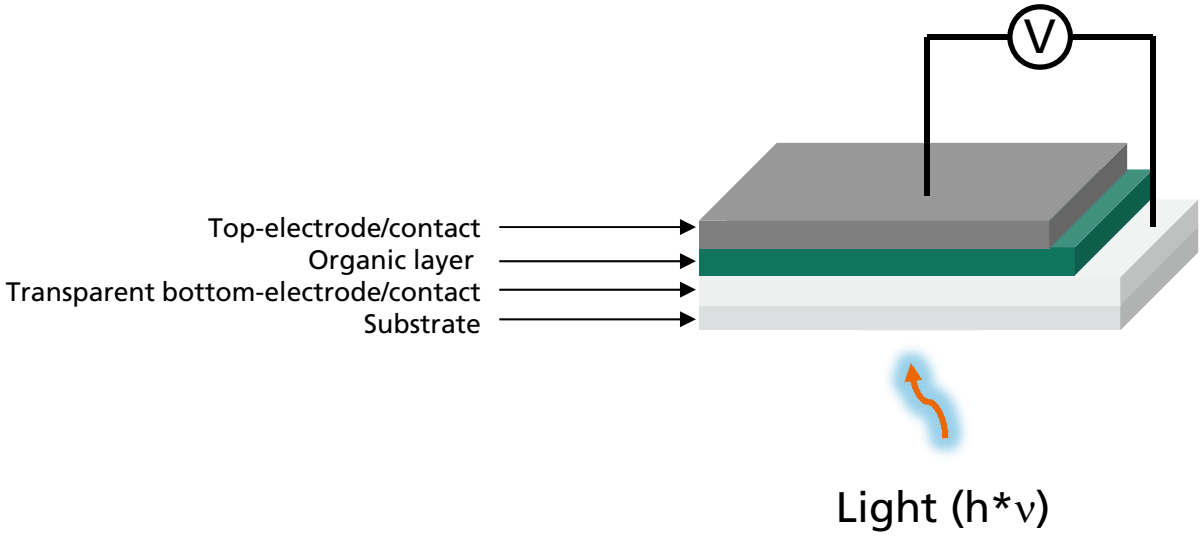
Organic Photodiodes - Basics

Standard architecture:



Functional principle: Conversion of a photon flux into charge carriers, generating a photo current. An external BIAS voltage can enhance the electric field and improve the generation of charge carriers.

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Organic Photodiodes at COMEDD - Introduction

Thickness of the organic layers: < 150 nm → low absorption cross section of particle irradiation

simple sensitivity adjustment from 300 to 800 nm, or even more

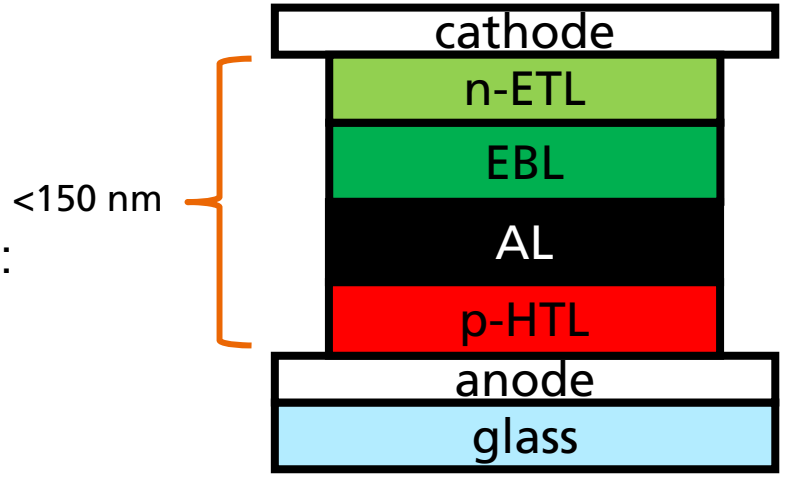
low dark current with proper stack modification: < 10^{-4} mA/cm^2

Linear behaviour between signal and light intensity over more than 3 magnitudes

Capacitance lower than 500 pF/mm^2

Rectification of 10^4 or higher (from -1 to +1 V)

General stack architecture



ETL – electron transport layer
EBL – exciton blocking layer
AL – absorption layer
HTL – hole transport layer

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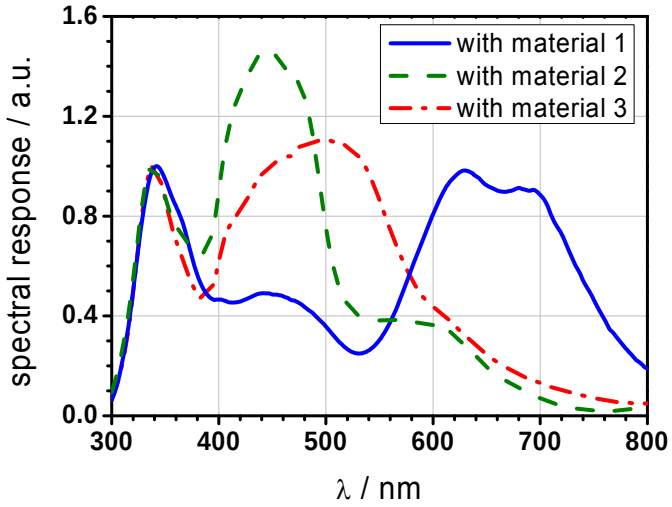
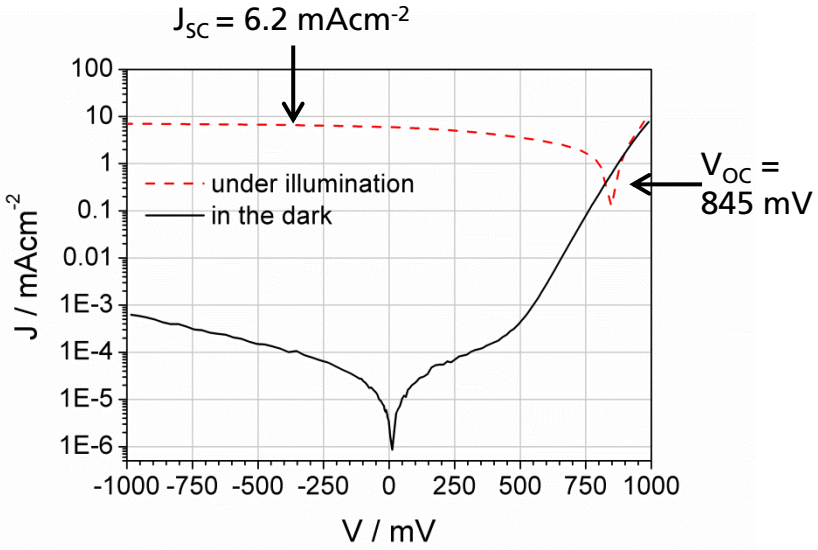
Organic Photodiodes - properties



Spectral sensitivity in dependence on the material composition.



J-V curve of an organic photodiode

- Properties such as spectral sensitivity, capacitance and dark current can be adjusted
- OPDs show better sensitivity values in blue and UV than Si based photodiodes

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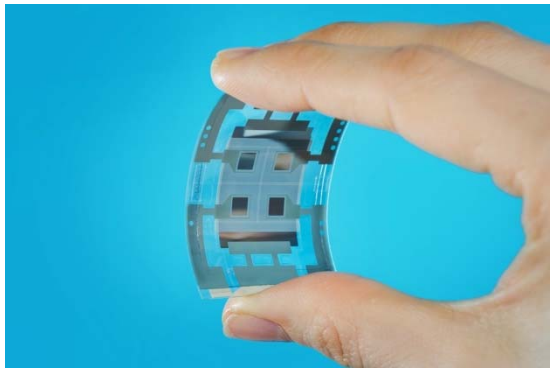
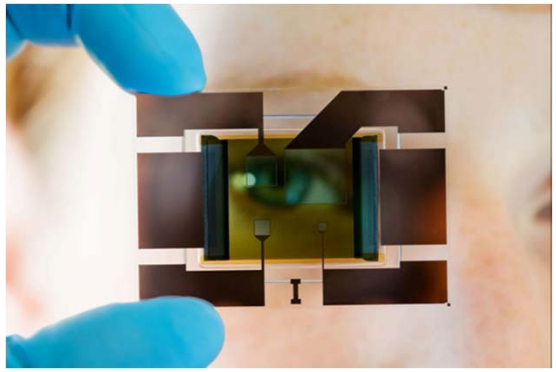
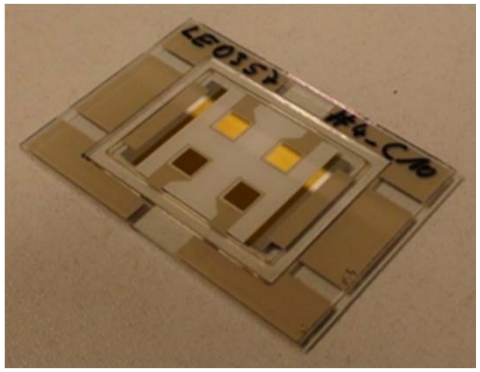
Properties of Organic Photodiodes (OPD)

- Spectral sensitivity is tunable toward application requirements
- High freedom in device shape and size
- Devices can be flexible
- Devices can be transparent
- Devices can be thin (<100 µm is possible) and lightweight
- Arrays of photodiodes are possible







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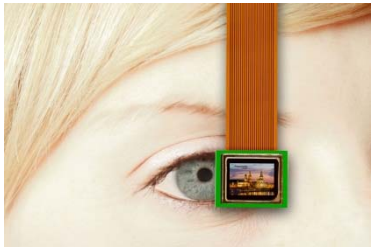
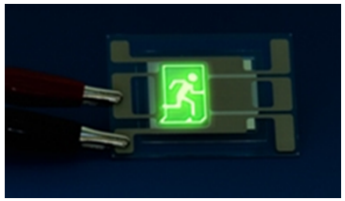
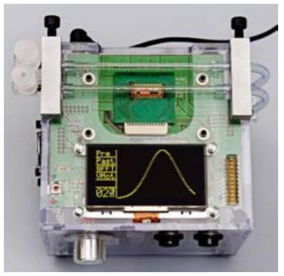
Conclusion: Research Topics in Organic Electronics

- Fraunhofer FEP is doing research on organic devices like OLED, OPD and OSC
  - **Hot research topics:** OLED patterning by photolithography and (N)IR-OPD
- Fraunhofer FEP is using flexible (polymer foils, metal band, thin glass) and rigid substrates (glass, 200 mm silicon wafer)
- Fraunhofer FEP applies thin film encapsulation techniques like ALD or Vitex
- Fraunhofer FEP addresses applications like OLED Microdisplays for video googles and data glasses, photonic sensing units, OLED based reticles, lighting and signage, photonic medical devices

- We are looking for partners for application driven joint developments either in public funded projects or on contract base.

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- For further information and device demonstration please visit our booth 1032
- Contact
  - Dr. Olaf R. Hild (Fraunhofer FEP)
  - olaf.hild@comedd.fraunhofer.de
  - Phone:+49-351-8823-450
  - www.fep.fraunhofer.de

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