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FRAUNHOFER INSTITUTE FOR ORGANIC ELECTRONICS, ELECTRON BEAM AND PLASMA TECHNOLOGY FEP

PRESS RELEASE

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In cooperation with

RAITH
NANOFABRICATION

Micropatterning OLEDs using electron beam technology

The Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP will be presenting the first micro-OLEDs patterned using electron beam at Booth 1023 during SID Display Week 2016 in San Francisco / USA from May 24–26.

Fraunhofer FEP has years of experience in the field of processing organic semiconductor materials. Scientists here are also developing organic light-emitting diodes (OLEDs) and OLED microdisplays based on organic semiconductors. Currently, techniques and new applications of electron beam technology – an additional area of core expertise at Fraunhofer FEP – are being particularly investigated in the field of organic electronics. Due to their outstanding optical and electronic properties, OLEDs have a broad range of potential applications in mobile electronics and displays. Especially small displays with high pixel density, such as OLED microdisplays, are necessary for future applications such as augmented- or virtual-reality, for example. Researchers are now working on further miniaturizing while maintaining high resolution. The patterning of the organic layers in OLEDs represents one of the biggest challenges, as conventional methods such as photolithography cannot be applied to organic semiconductor materials easily.

Fraunhofer FEP scientists have developed a novel approach to pattern the emission area of an OLED at high resolution. The patented technology uses an electron beam process, which takes place after finalizing the OLED including the encapsulation. Therefore it is possible to build the OLED highly productive and completely unpatterned, before the emission is individually modified by an adjusted electron beam process. The energy of the electrons determines their penetration depth in the layer stack. With a suitable choice of process parameters, the encapsulation can also be penetrated by the electron beam and the luminous characteristics of the organic layers beneath will change without destroying or compromising the encapsulation itself. Depending on the application, it is even possible to modify individual layers directly.

"Continuous gray scales in an image can be created on a monochrome OLED using the electron beam, while at the same time the local current consumption is reduced. The longer the dwell time on one spot with the beam, the darker the OLED will appear there", explains Elisabeth Bodenstein from the development team at Fraunhofer FEP. "An impressive example is the white OLED shown, in which the image of the famous Dresden Semperoper was structured with the electron beam in a hundred seconds."

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Even with a write time of less than two minutes, an impressive resolution of 12,700 dpi was attained – corresponding to 2 µm spacing of the image dots. The structuring of the OLED was carried out with an electron beam lithography system of Raith GmbH, the leading manufacturer of nanofabrication systems.

The process is highly adaptable – regardless of whether the OLED is applied to a rigid medium or flexible film, what color the OLED is, or whether the substrate is optically opaque, translucent, or transparent. The size of the substrate is universal as well and can be matched to the corresponding application. An enhancement to full-color patterning is being planned.

The Fraunhofer FEP scientists are now prepared to put this new technology into practice with industrial partners. The technology was developed within a project funded by the Fraunhofer Gesellschaft.

Fraunhofer FEP at the SID Display Week 2016

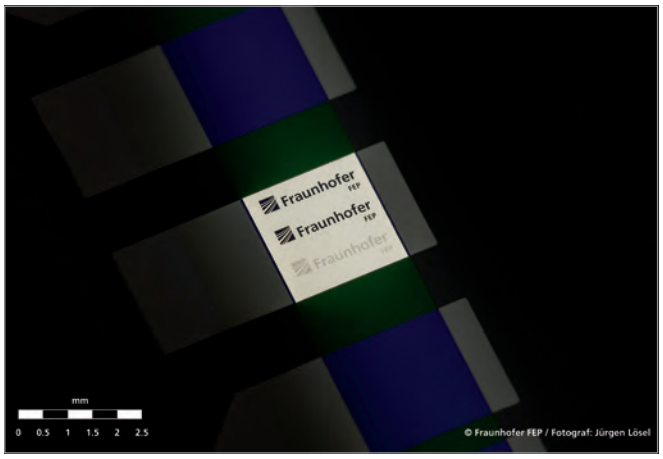
Invited Talk
»OLED Microdisplays: Enabling Advanced Near-to-Eye Displays, Sensors, and Beyond«
Dr. Uwe Vogel, Session 52: OLED Displays II (Paper Number 52.2)
May 26, 2016, San Francisco Moscone Convention Center, Room 131

Exhibitor Forum
»Electron Beam Induced High-Resolution Modification of OLED Emission«
Elisabeth Bodenstein

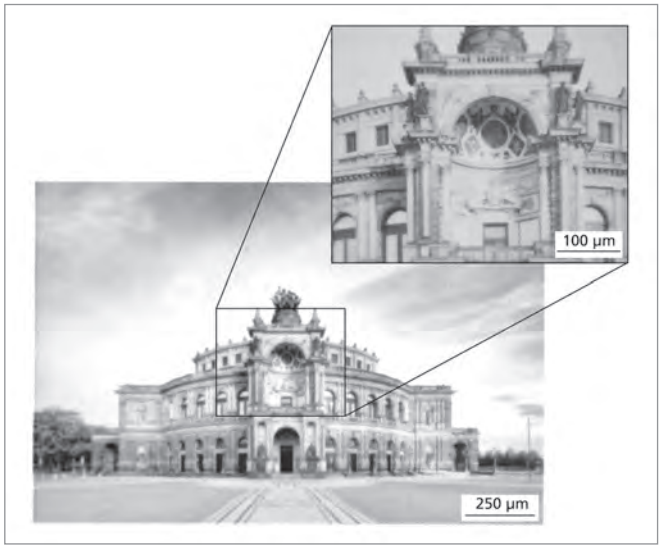
Poster
»Electron Beam Induced High-Resolution Modification of OLED Emission«
Elisabeth Bodenstein, Poster number 208
May 26, 2016, San Francisco Moscone Convention Center, Room City View (Metreon)

Announcement

Fraunhofer FEP is pleased to be host of next SID ME 2017 Chapter Spring Meeting on March 13 – 14, 2017 in Dresden. First Call-for-Papers here:
www.fep.fraunhofer.de/sidme17



OLED patterned with an electron beam
(Patterning: A. Rudzinski, Raith GmbH)
© Fraunhofer FEP / Photographer: Jürgen Lösel
Picture in printable resolution:www.fep.fraunhofer.de/press



OLED patterned with an electron beam
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The **Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP** works on innovative solutions in the fields of vacuum coating, surface treatment as well as organic semiconductors. The core competences electron beam technology, sputtering and plasma-activated deposition, high-rate PECVD as well as technologies for the organic electronics and IC/system design provide a basis for these activities. Thus, Fraunhofer FEP offers a wide range of possibilities for research, development and pilot production, especially for the processing, sterilization, structuring and refining of surfaces as well as OLED microdisplays, organic and inorganic sensors, optical filters and flexible OLED lighting. Our aim is to seize the innovation potential of the electron beam, plasma technology and organic electronics for new production processes and devices and to make it available for our customers. COMEDD (Center for Organics, Materials and Electronic Devices Dresden) with all known activities in organic electronics is now acting as a new business unit at Fraunhofer FEP, Dresden, Germany.