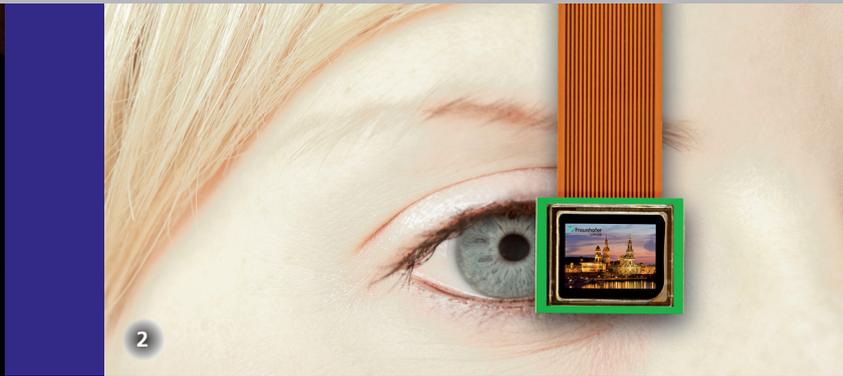


1 OLED structured with FMTL-technology (©VON ARDENNE Anlagentechnik GmbH).

2 Bidirectional OLED microdisplay.



## COLOR-FILTER-LESS FULL-COLOR OLED MICRODISPLAYS

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### Exposé

For several years Fraunhofer COMEDD has been working on the integration of organic light emitting diodes (OLED) into silicon. OLED-on-silicon technology enables e.g. the fabrication of miniaturized displays, so called OLED microdisplays. Furthermore also miniaturized electro-optical sensors like e.g. light barriers or optocoupler could be manufactured by using this technology.

OLED microdisplays are used for example in data eyeglasses for the presentation of virtual or augmented information. Moreover OLED microdisplays are also applied in view finders of digital cameras. Depending on the application monochrome or colored microdisplays are needed. As of today the lower limit for patterning organic layers is at pixel pitch about 50  $\mu\text{m}$  using conventional technologies – thus infeasible to apply for OLED microdisplays with

smaller pixel pitches of approximately 8  $\mu\text{m}$  or below. For those OLED microdisplays all sub-pixels are coated with a white OLED and a color filter is arranged in front. This filter is able to separate red, green and blue sub-pixels. The disadvantage is, that the color filter causes enormous losses in the light brightness and brilliance. The reason is, that approximately 2/3 of the spectral range of the white pixels are always cut off for the colors that are not needed, and white OLED is itself less efficient than monochrome, therefore approximately 20 % of the emitted light could be used.

Together with VON ARDENNE Anlagentechnik GmbH Fraunhofer COMEDD introduces a technology, that enables to pattern OLED microdisplays on sub-pixel level. Therefore VON ARDENNE has developed a flash-mask-transfer-lithography (FMTL), which has been applied for Fraunhofer COMEDD's microdisplays.

Especially for mobile applications like data eyeglasses or camera view finders high luminance and low power consumption are needed. The conventional approach based on white OLED and color filters has its limits because the high luminance causes significant decrease of the operating lifetime. By introducing FMTL to OLED microdisplays we now can eliminate this disadvantage.

Furthermore there is a general trend in OLED displays to achieve true color by using

three different monochrome emitter. That trend gets more demanding at upcoming pixel densities in high-definition mobile (small/medium size) displays. OLED microdisplays exhibit the ultimate pixel density/resolution and patterning feature size specification. The cooperation with VON ARDENNE Anlagentechnik GmbH enables Fraunhofer COMEDD to implement FMTL in color-filter less OLED microdisplays with potentially improved efficiency, brightness, lifetime and color gamut.

### FMTL-Technology

The FMTL-technology works with special transfer masks. Organic layers are locally deposited through the masks via thermal heat input and transferred to the microdisplay. Thus sub-pixels with a size smaller than  $10\ \mu\text{m} \times 10\ \mu\text{m}$  can be coated. Therefore adjacent red, green and blue monochrome sub-pixels on microdisplays can be manufactured, the color-filter replaced completely, eventually the efficiency increases significantly.

