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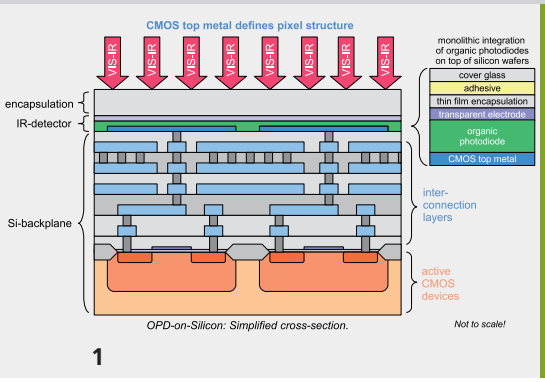

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1 *Cross section of OPD-on-Silicon*
2 *OPD-on-CMOS image sensor*

ORGANIC PHOTODIODES, OPD-ON-CMOS IMAGE SENSORS

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Motivation
Organic Photodiodes on CMOS

Optical sensors are pervasive. Domestic life as well as the industrial environment are hard to imagine without them. For example, digital cameras using CMOS detectors have been indispensable vacation companions for many years, while in industry they serve as a simple and economical solution for automated image processing (such as in quality control applications, remote presence and position recognition and counting in conveyor systems, and object recognition in warehousing logistics). They can also be employed in medical engineering for diagnostic image processing. There are many future applications in the field of autonomous vehicles that are already foreseeable today.

However, the detectable spectral range of CMOS sensors often is limited to the visible wavelength range. The above-mentioned applications partly need detection outside this range – for example in the NIR-range. This functionality usually is realized by hybrid solutions such as a combination of indium gallium arsenide (InGaAs) detectors on CMOS readout circuits. Nevertheless, the manufacture of these kinds of hybrid solutions is considerably more costly, which limits the use in some applications. This is where organic photodiodes offer an interesting alternative because they can be monolithically integrated at wafer-level on top of high-performance CMOS readout circuits.

Technology

Fraunhofer FEP has extensive experience in integrating organic layers on CMOS wafers. Until now the focus was set on the integration of emitting layers for OLED microdisplays. This know-how in processing can now be used for the integration of organic photodiodes (OPD).

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For demonstration purposes a first ASIC has been developed, which offers the possibility to read out an organic layer with SVGA-resolution (800 × 600 pixels). This image sensor was fabricated completely at wafer-level and therefore already under near-production conditions. With its extended region of sensitivity, the imager can be employed over the entire bandwidth of conventional applications in industry, automotive sector, and medicine. They could be used for quality control of foodstuffs, as fingerprint sensors, and in biomedical tests, for example.

With the possibility to adjust and optimize the organic layer system the realized demonstrator builds a platform for customer specific sensor developments.

At the same time the access to such developments is facilitated because it can be resorted to an existing development environment consisting of ASIC readout-chip, control electronics and software.

Our Offer

- Evaluation kit of an initial OPD sensor incl. readout electronics by USB interface and easy to use configuration of the image sensor via configuration software
- Evaluation of organic sensor layers
- Customer specific adjustment of the organic sensor layer system according to the application-specific needs and wavelengths
- CMOS backplane design for adjustment of the sensor performance like e.g. resolution, pixel- and sensor size, framerate or to comply with specific organic layers
- Application studies of new image sensors based on organic photodiodes

Fraunhofer FEP is ready and available for customer specific developments, prototyping and manufacturing of small series. Together with an established manufacturing partner we can also offer higher volume quantities commercially.

Parameter	
Resolution of sensor	800 × 600
Active area	12.8 mm × 9.6 mm
Display diagonal	0.6“
Pixel setup	Organic Photodiode
Pixel pitch	16 µm × 16 µm
Camera interface	8bit grayscale digital, parallel + synchronization signals CLK, HS, VS and DE
Configuration interface	TWI (two-wire-interface)
Exposure time	Typ. 1 ms ... 3 ms
Shutter	Global Shutter
I/O voltage	1.6 V … 5.5 V
Core voltage	1.6 V … 2.0 V
Temperature range	-20°C – +65°C
CMOS technology	0.18 µm

3 *Standard CMOS image sensor of a bidirectional microdisplay. In the middle a VIS-Cut filter with a wavelength of >780 nm can be seen*

4 *Comparable arrangement like in Fig. 3 but with an OPD image sensor. The landscape, which was covered by the filter, now is visible because of the extended sensitivity*

5 *Evaluation Kit*

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