# New Sub-pixel Structured OLED Microdisplay

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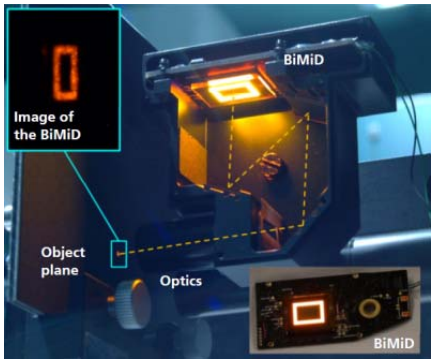
Outline

1. Motivation
2. Sub-pixel structuring process
3. Demonstrators at the exhibition
4. Outlook

# 1. Motivation

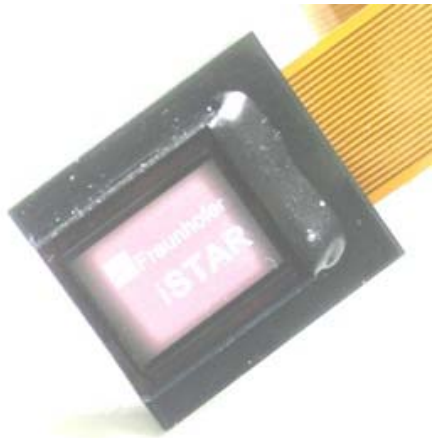
- Microdisplay Applications
  - Data glasses
  - Pico projectors
  - Head-up displays
  - Sensors

- Microdisplay demands
  - Coloured
  - High brightness > 10.000 cd/m$^2$
  - Low Power
  - High resolution
  - Small dimensions
  - Low priced manufacturing

# 1. Motivation

- Coloured vs. Brightness dilemma
  - State-of-the-art
    - White OLED matrix + colour filter (CF)
    - 2/3% loss of luminance by colour filtering
    - Colour filter transmission losses
      - Up to 80% reduction of brightness
- Possible solution
  - Sub-pixel structuring of red, green & blue emitters
    - Reduction of colour filter losses
    - Use of efficient OLED stacks for each colour

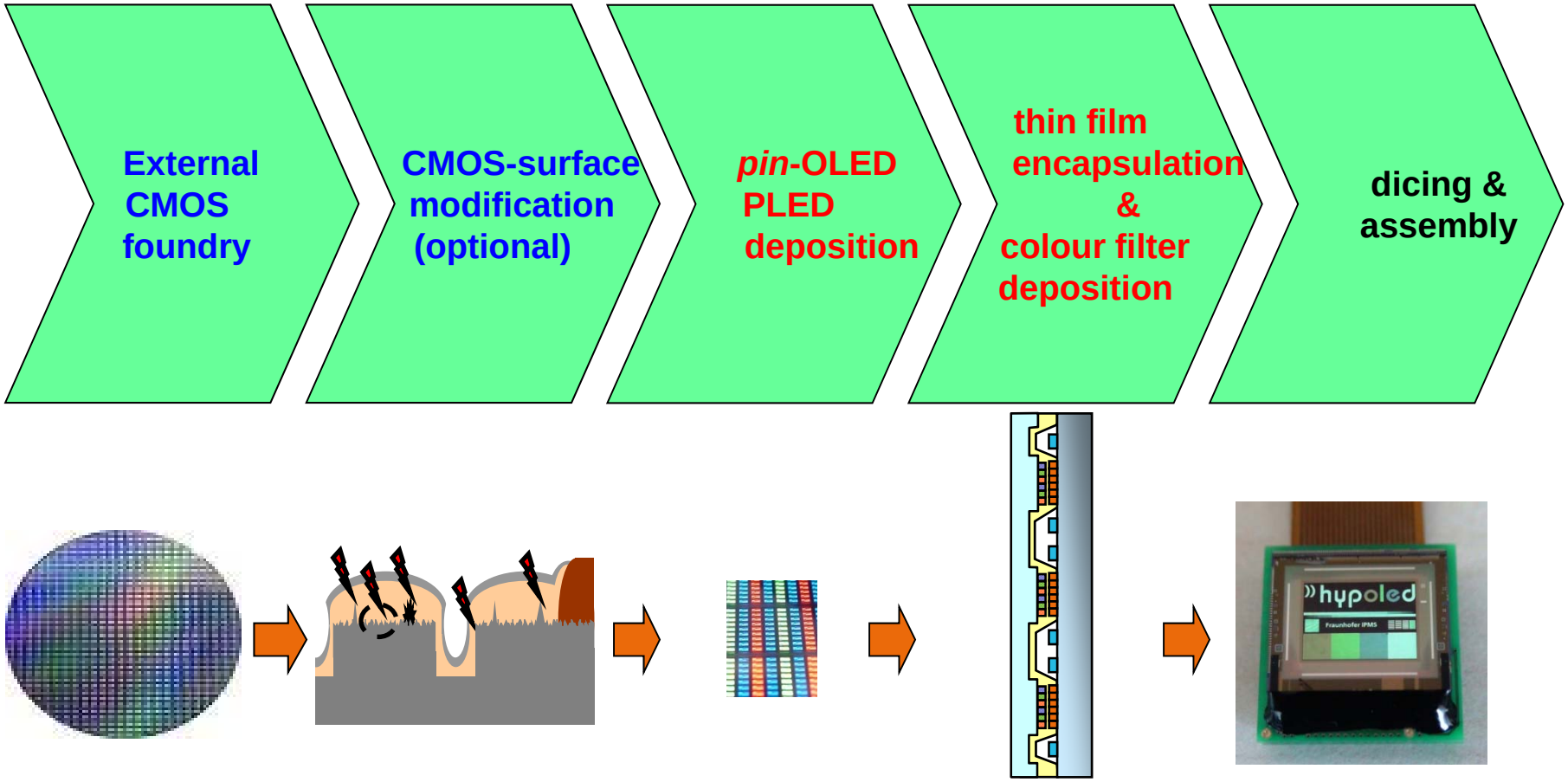


Microdisplay without CF


Microdisplay with CF

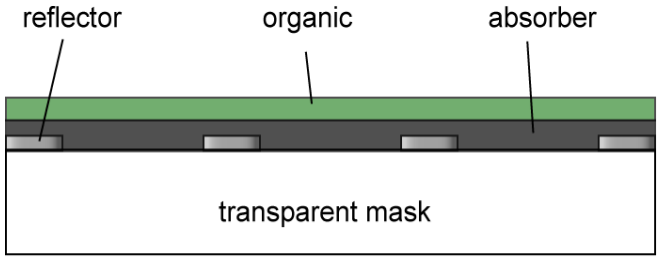
# 2. Sub-pixel structuring process

- Standard OLED-on-Silicon process flow

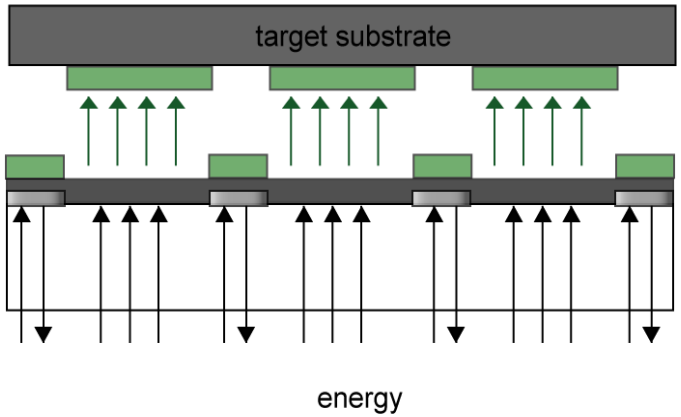


# 2. Sub-pixel structuring process

- Flash-Mask-Transfer-Lithography
  - Transfer mask
    - Donor substrate
    - Patterned reflectors and absorbers
    - Absorber define the pixel geometry
    - Organic emitter is deposited on the top

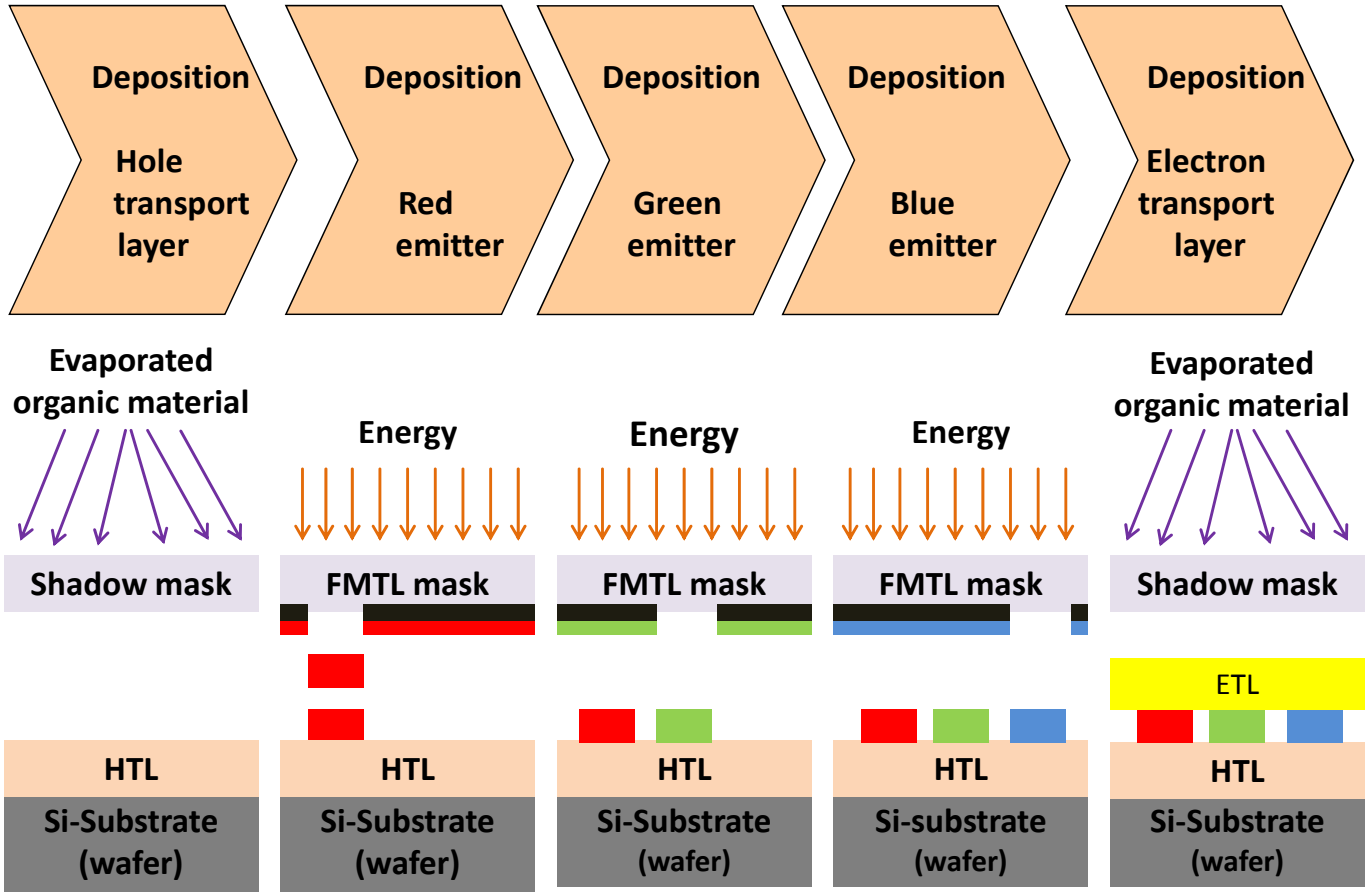



  - Transfer process
    - Target aligned to the FMTL mask
    - Energy on the mask bottom
    - Material above the absorber is evaporated and transferred to the target



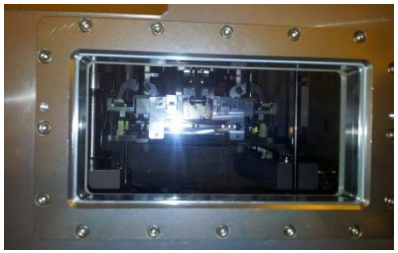
# 2. Sub-pixel structuring process

- Manufacturing steps of color sub-pixel structured OLED microdisplays



# 2. Sub-pixel structuring process

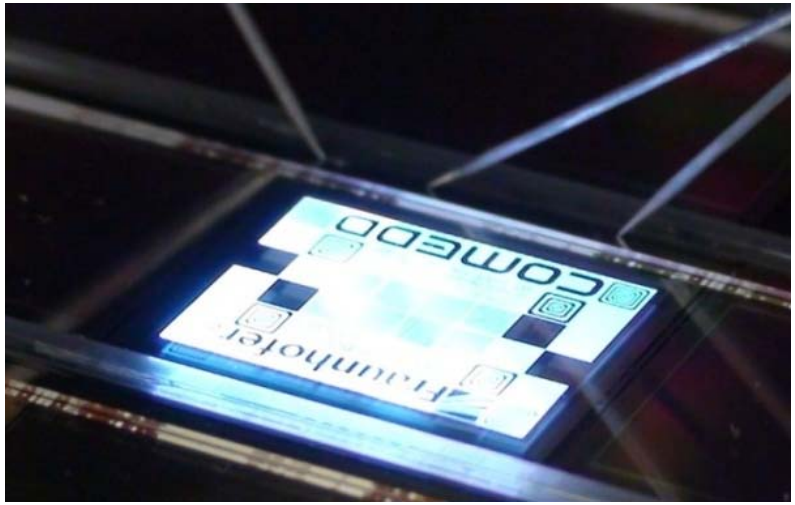
- OLED-Microdisplay Cleanroom
  - 300 $m^2$ clean room class 10
  - Etching / Sputtering Clustex 200 | Leybold Optics
  - Spin coating EVG120 | EVG
  - Etching, deposition by thermal evaporation, ebeam and Barix™ thinfilm encapsulation
  - Full-automated wafer bonding system Hercules | EVG
  - Photolithography (Nanoimprint). EVG IQ + Brewer automatic processing station.
  - Wafer prober Pegasus PA200 | Wentworth

# 3. Demonstrators at the exhibition

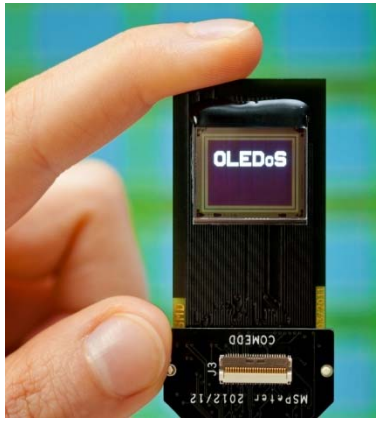
- Test Display for FMTL process evaluation
  - Designed for 180nm CMOS-process
  - Test structures down to 8µm x 8 µm
  - Evaluated with a standard OLED deposition

Wafer test



Layout

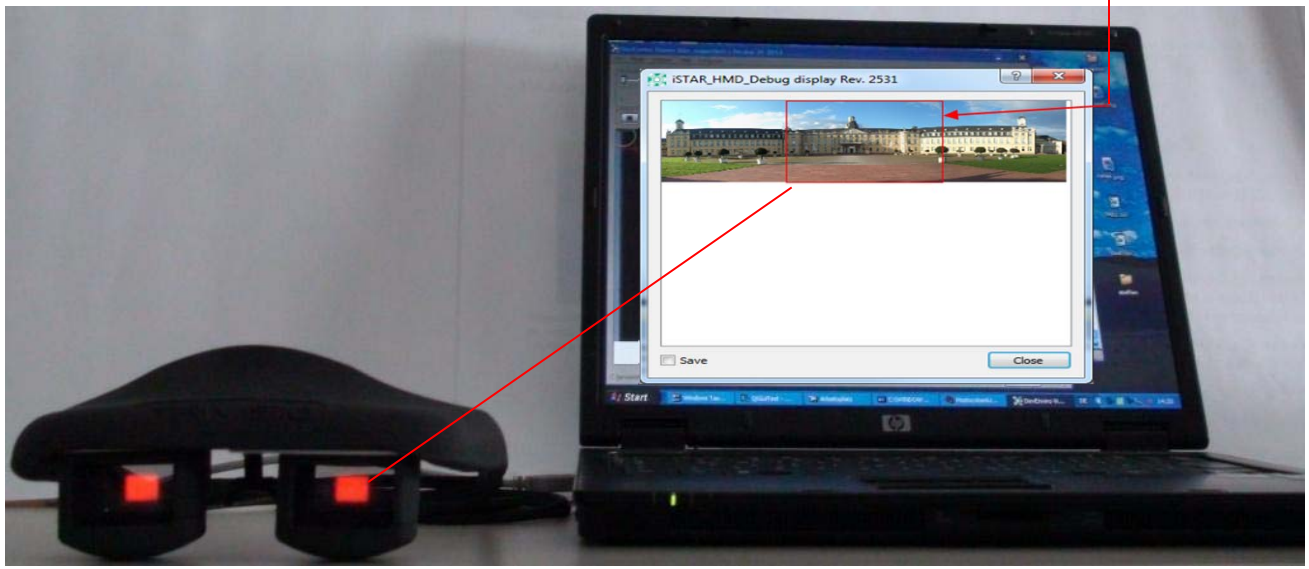

Exhibited demo



# 3. Demonstrators at the exhibition

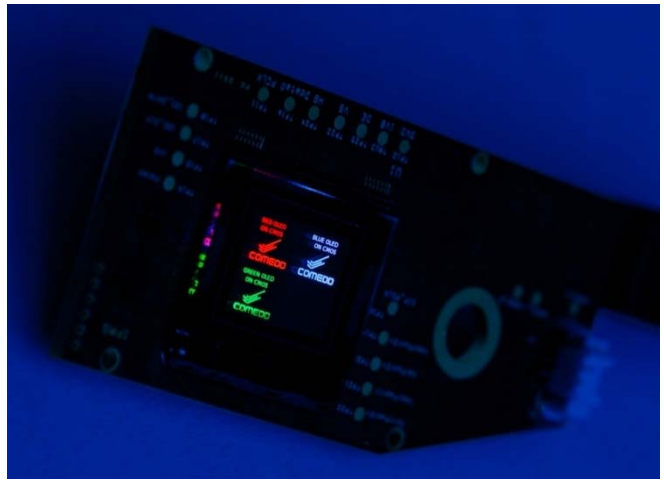
- Interactive Data glasses
  - Panorama view „Castle of Karlsruhe“
  - Moved by the users eye

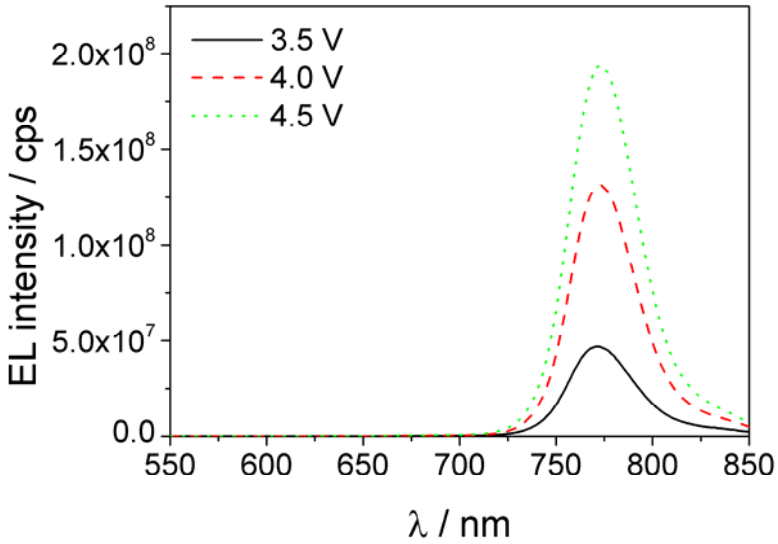
Gaze triggered Point of view



# 3. Demonstrators at the exhibition

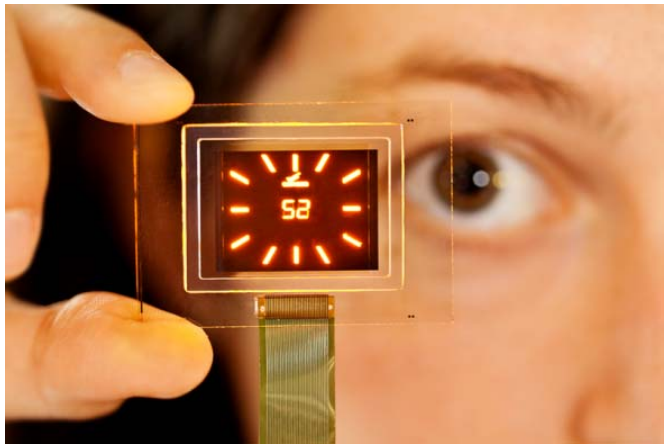
- NIR active OLEDs and their in tegration in CMOS Microdisplays
  - Co-integration with OLED emitters in the visible area
  - Integration on transparent and flexible substrates also possible

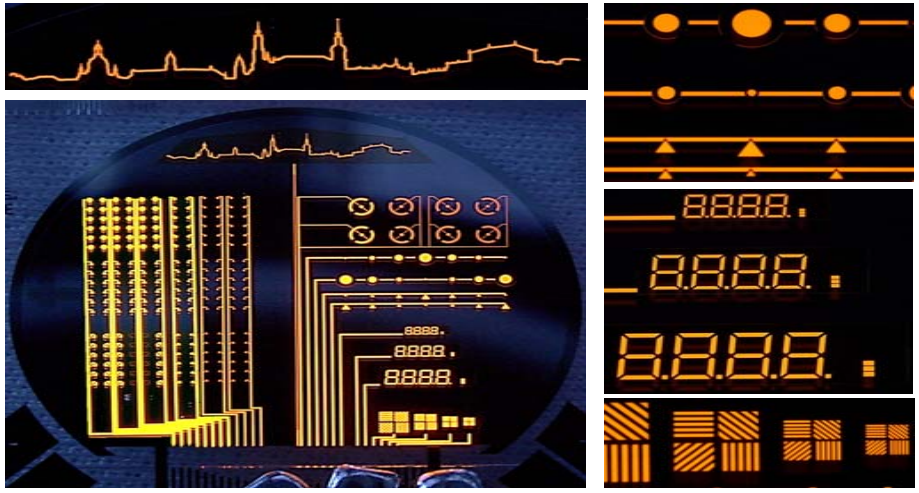


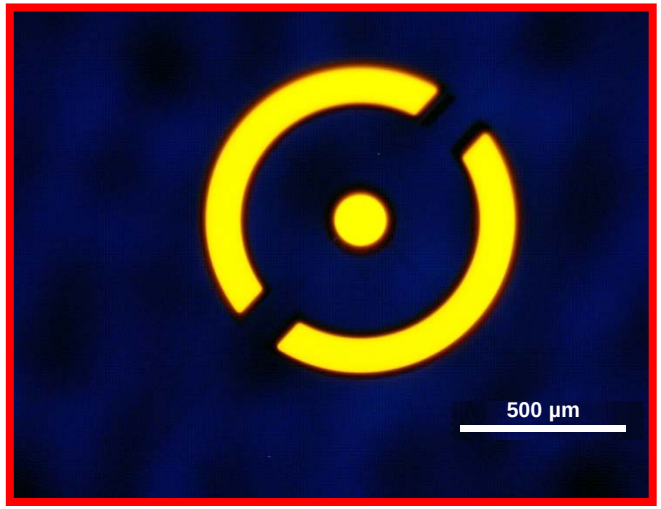



# 3. Demonstrators at the exhibition

- OPTICAL MICROSTRUCTURES WITH OLED
  - Top and bottom emitting OLEDs
  - OLED structures on transparent glas
  - Smallest feature size 5µm
  - Local control electronic
  - Customized layouts possible







# 4. Outlook and Acknowledgement

- Outlook
  - First true RGB OLEDs on microdisplays
  - Manufacturing process optimiszation

- Acknowledgement
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**Thank you for attention**