



PHOTONICS PUBLIC PRIVATE PARTNERSHIP



*H2020-ICT-2015
Cross-cutting ICT KETs*

PI - SCALE

Bringing flexible organic electronics to pilot innovation scale

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Design guidelines and standards and costs for OLED strips included in design handbook

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PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

PI-SCALE

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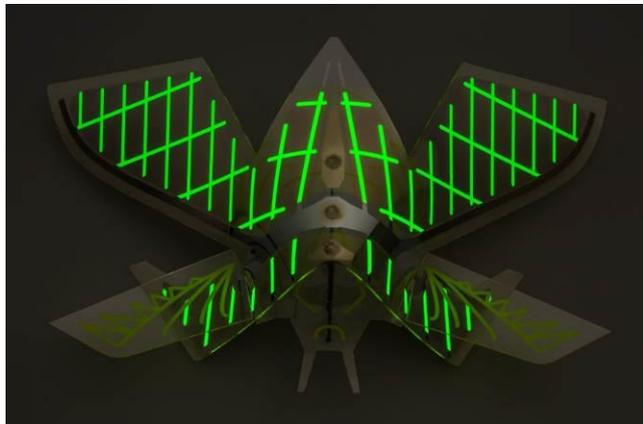
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1. Design guidelines

Unique design features of flexible OLEDs: foldable, twistable, bendable, conformable, transparency, large area illumination, fine pattern of design.

FOLDABLE



BENDABLE, TWISTABLE



FINE PATTERN OF DESIGNS



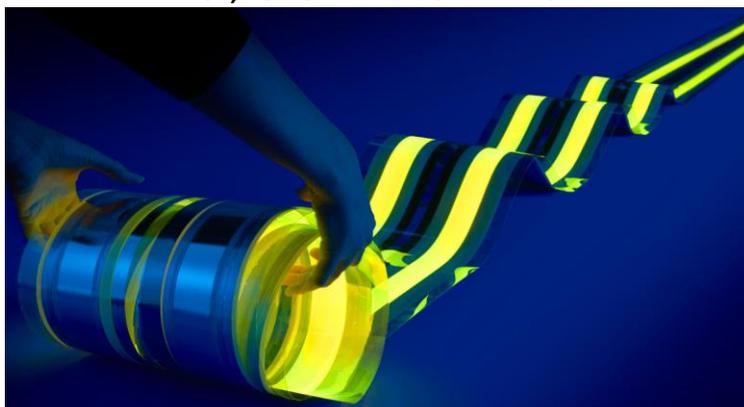
CONFORMABLE



TRANSPARENCY



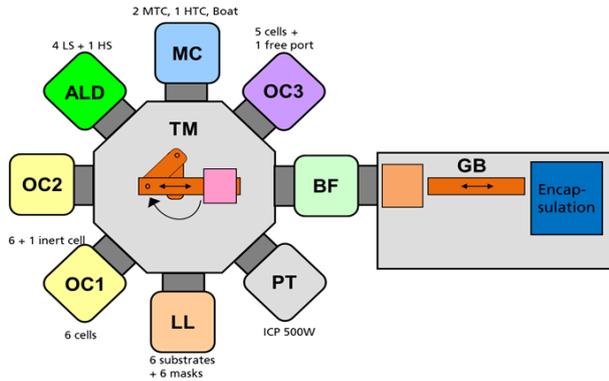
LARGE, LONG AREA ILLUMINATION



2. OLED manufacturing guidelines

S2S (sheet-to-sheet) processing is a batch process which is limited to size of 152 mm x 152 mm or alternatively 200 mm x 200 mm. R2R (roll-to-roll) processing is continuous moving web process which is limited to web width of 300 mm.

2.1. S2S OLED manufacturing

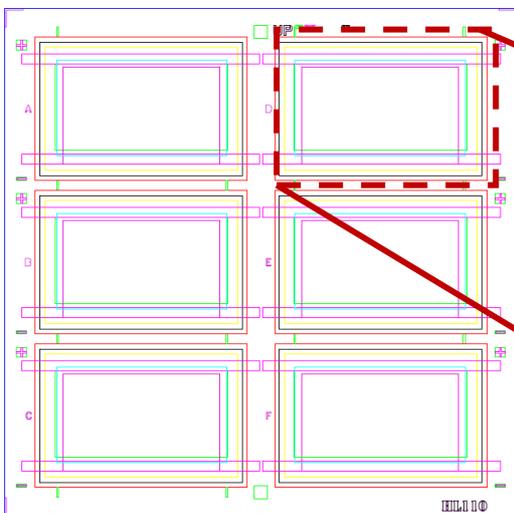


TM: transfer module
 LL: load lock
 PT: plasma treatment
 OC: organic deposition chamber
 MC: metal deposition chamber
 ALD: atomic layer deposition
 BF: buffer chamber
 GB: glove box (under Nitrogen)

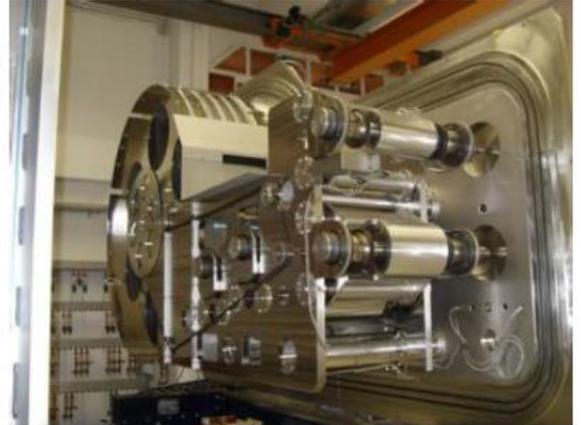
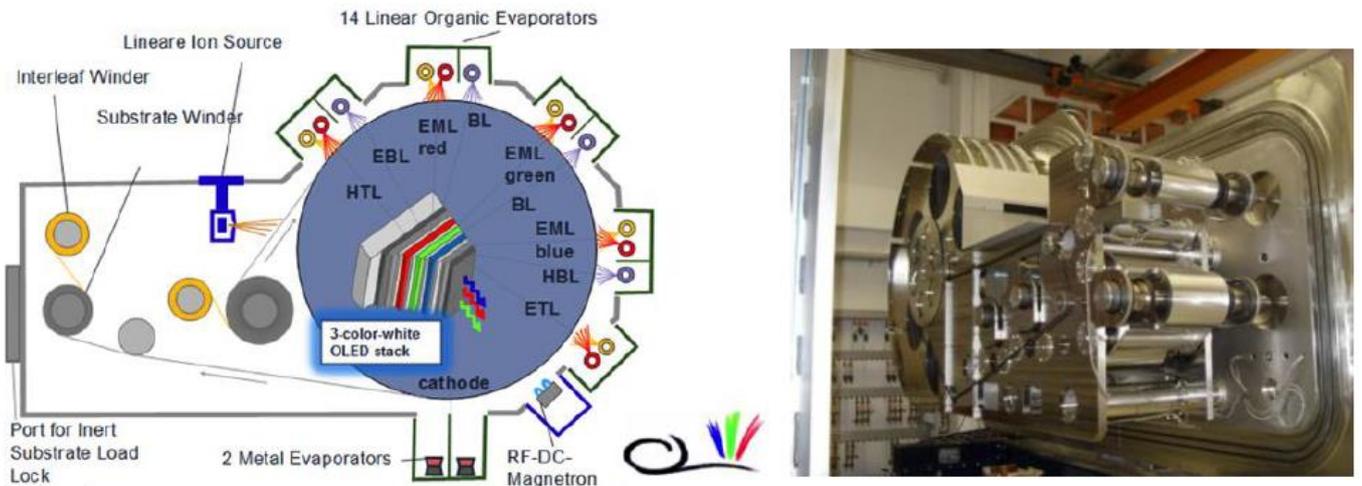


S2S Evaporated OLED							
	Bottom barrier	Anode & Structuring	OLED & Cathode	Encapsulation	Debonding & Singulation	Characterization and testing	System integration
	S2S structured bottom barrier	Photolitho structured ITO and MAM	OLED and Cathode evaporation	TFE	Mechanical debonding and singulation	Acc. shelf lifetime; Device el. characterization	Component assembly, inj. molding ...

An example of S2S OLED layout with the overall plate dimensions of 152 mm x 152 mm. The layout comprises of 6 individual OLED elements. A substrate with OLED element is separated from the plate.

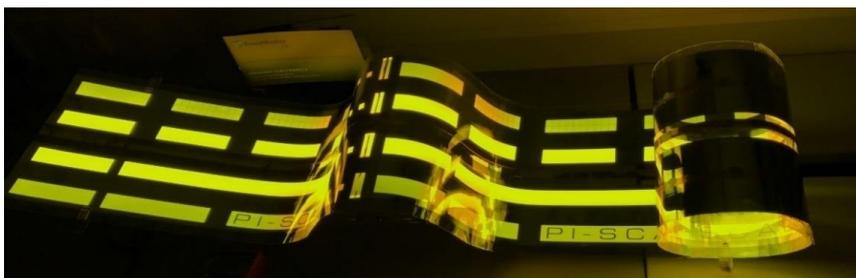
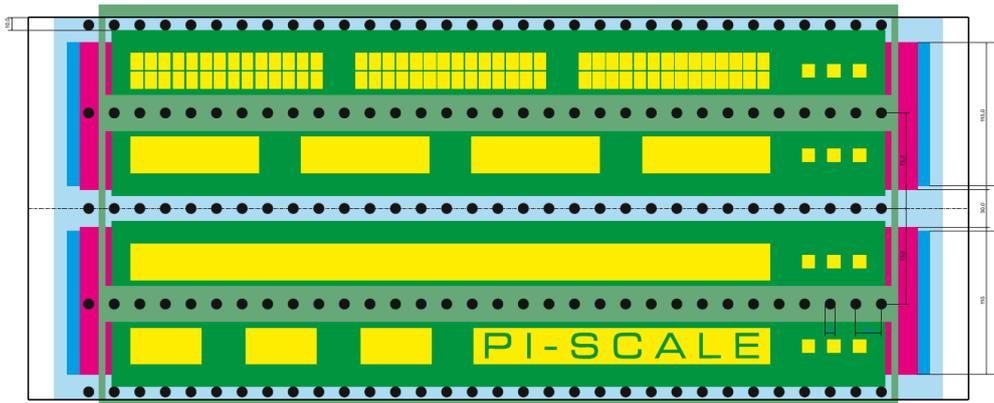


2.2. R2R evaporated OLEDs



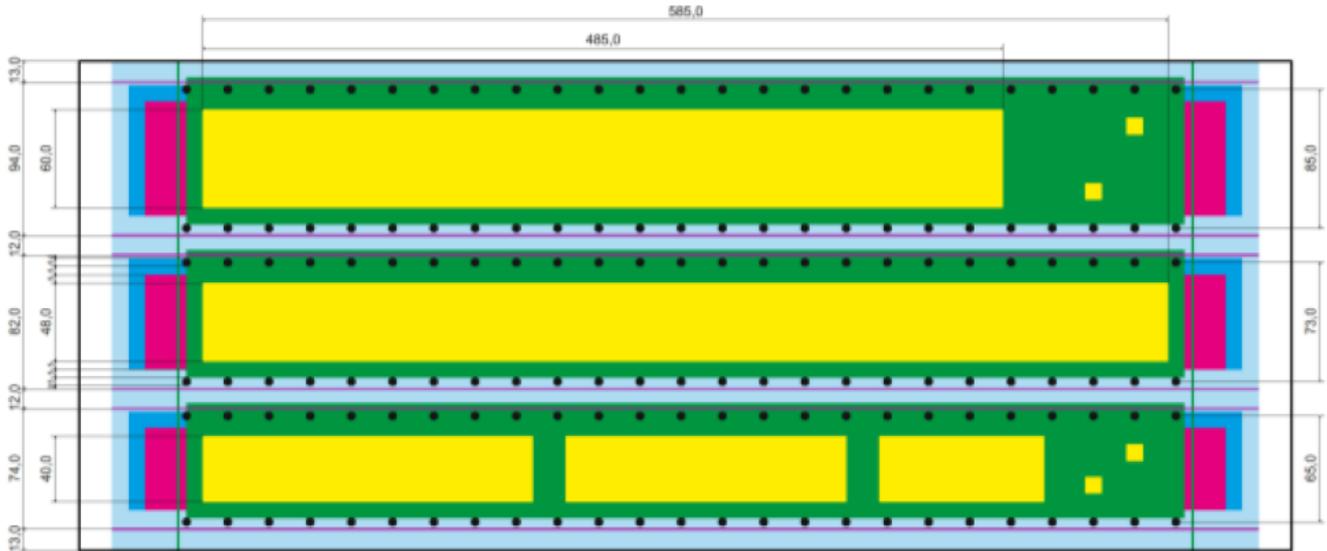
R2R Evaporated OLED					Singulation	Characterization and testing	
	Bottom barrier	Anode & Structuring	OLED & Cathode	Encapsulation			System integration
	HC R2R barrier, thin glass	ITO, ISO printing	OLED and Cathode evaporation	Lamination of HC R2R barrier	Roll slitting and cutting	Acc. shelf lifetime; Device el. characterization;	Component assembly, inj. molding ...

An example of R2R OLED layout with the overall dimensions of **300 mm x 600 mm**. The layout comprises of 24 individual OLED elements with variable sizes. As shown in picture below, the whole roll of OLED has been lit up.

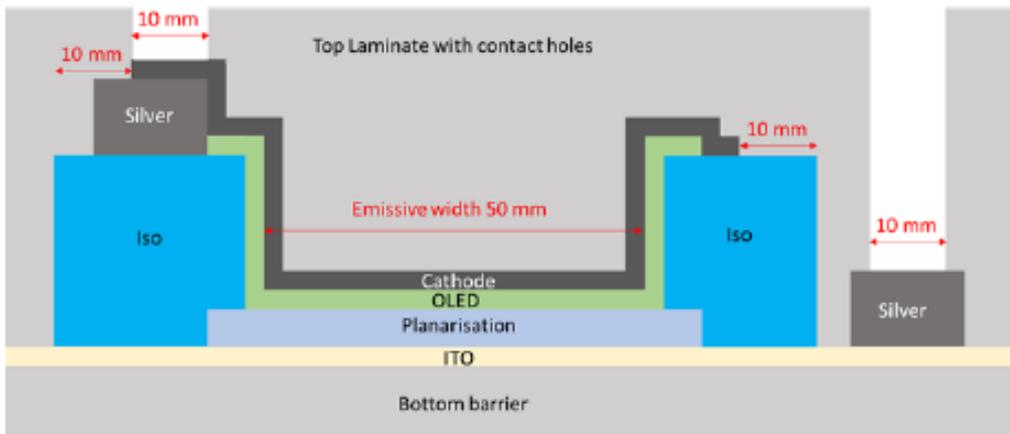


2.3. R2R hybrid OLEDs

An example of R2R hybrid OLED layout with the overall dimensions of **0.3 m x 15 m**. The layout comprises of two individual OLED strips. It is the OLED source produced using a unique R2R process that combines the performance of an evaporated OLED stack with solution processing of auxiliary layers. Moreover, the combination improves the process reliability and enables fabrication of devices of any length and emissive pattern.



An example of the mask design for the fully evaporated R2R OLED devices (light blue: ITO, green: isolator, magenta: organics, dark blue: cathode, yellow: emitting area, black: contact holes in top encapsulation for power supply).



The cross section of the resulting device stack drawn to vertical scale.



Full R2R OLED lighting up.

Bezel size

- Standard 20mm on cathode side (- contact), 40mm on anode side (+ contact); minimum 15mm (- contact); 35 mm (+contact). The OLED can be cut-to-fit perpendicularly to the lighting area. 10mm wide not lighting bezel is formed on the cut-side of the OLED in 1 year of shelf life.

Lighting area

- Practically, the OLED can be cut into the lengths of 50mm to 15m, although smaller OLEDs are also possible with large bezel/lighting area ratio and compromised lifetime.

Flexibility

- The OLED is flexible to >50mm bending radius.

Light output/efficacy

- 15lm/W @ 1000cd/m²

Contacting requirements

- The OLED has contact openings on both electrodes, along the light emitting area. The contact openings pitch is 35mm. We recommend to re-contact every 500mm of the OLED to ensure uniform lighting output. Best contacting practice is to stick a highly conductive tape (e.g. Al, or Cu) on contact openings along entire OLED unit.

3. Standardization

Standards to be used for flexible OLEDs in aerospace, automotive and furniture applications (functional, robustness and safety tests)

- General lighting:
 - Typical OLED panels are class III electrical appliances in accordance with IEC 61140 (Protection against electric shock) and IEC 60598-1 (Luminaires: General requirements and tests).
 - Safety requirements of OLED panels for use on d.c. supplies up to 120 V or a.c. supplies up to 50 V at 50 Hz or 60 Hz for indoor and similar general lighting purpose are defined in IEC 62868:2014.
 - IEC 62972:2016 establishes terms and definitions specific for general lighting OLED light sources and related equipment.
- Aerospace:
 - Depending on the position in the value chain (Tier 1 / Tier 2), qualification and certification for parts and the respective responsibility varies. Often, materials are predefined by the customer / OEM already at the inquiry stage. This requires no further testing or certification material-wise. For newly developed materials, specifications and requirements for continuous inspection during series production are jointly defined by customer and supplier.
 - Some of the most essential requirements for aircraft applications is fire resistance / fire retardancy and smoke development. Thus, all systems need to be tested, e.g. vertical fire testing 12 s according to FAR 25.853 (A), or smoke density and smoke toxicity test according to AITM3.0005.
 - Certification for passing those tests can be obtained by official aeronautical approved testing labs (e.g. DLR).
- Furniture:
 - DIN EN 60598-1 / IEC 60598
 - General requirements regarding luminaires with voltages below 1000 V
 - Classification, labeling, mechanical and electrical structure / assembly (e.g. creepage distances and clearances for HF >30 Hz), photobiological safety
 - DIN EN 60570 / IEC 34D/997/CD:2011 – Electrical supply track systems for luminaires
 - DIN 57710-14 / VDE 0710-14 – Luminaires with operating voltages below 1000 V; luminaires for building-in into furniture
 - DIN 4102-1 – Fire behavior of building materials and building components – Part 1: Building materials; concepts, requirements and tests
 - VdS 2324
 - DIN VDE 0711-1 / IEC 598-1 – Luminaires; part 1: general requirements and tests
 - Withdrawn, but replaced by DIN EN 60598-1
- Automotive:
 - Lifetime tests
 - High temperature storage test is defined in JESD22-A103-C
 - Temperature cycling is defined in JESD22-A104
 - High temperature humidity test is defined in JESD22-A101
 - Steady state live test is defined in JESD22-A108
 - Photometrical and colorimetrical tests according to the ECE standard (e.g. for cars and trailers based on ECE regulation 48).

4. Degree of Progress

The deliverable is 100% fulfilled.

5. Dissemination

The Deliverable 7.2 Design guidelines and standards and costs for OLED strips included in design handbook is public document.