

EPIC Online Technology Meeting with Special focus on
CMOS Imagers Applications (in cooperation with EMVA)

>> Microlenses for imagers @ CSEM SA

Frédéric Zanella

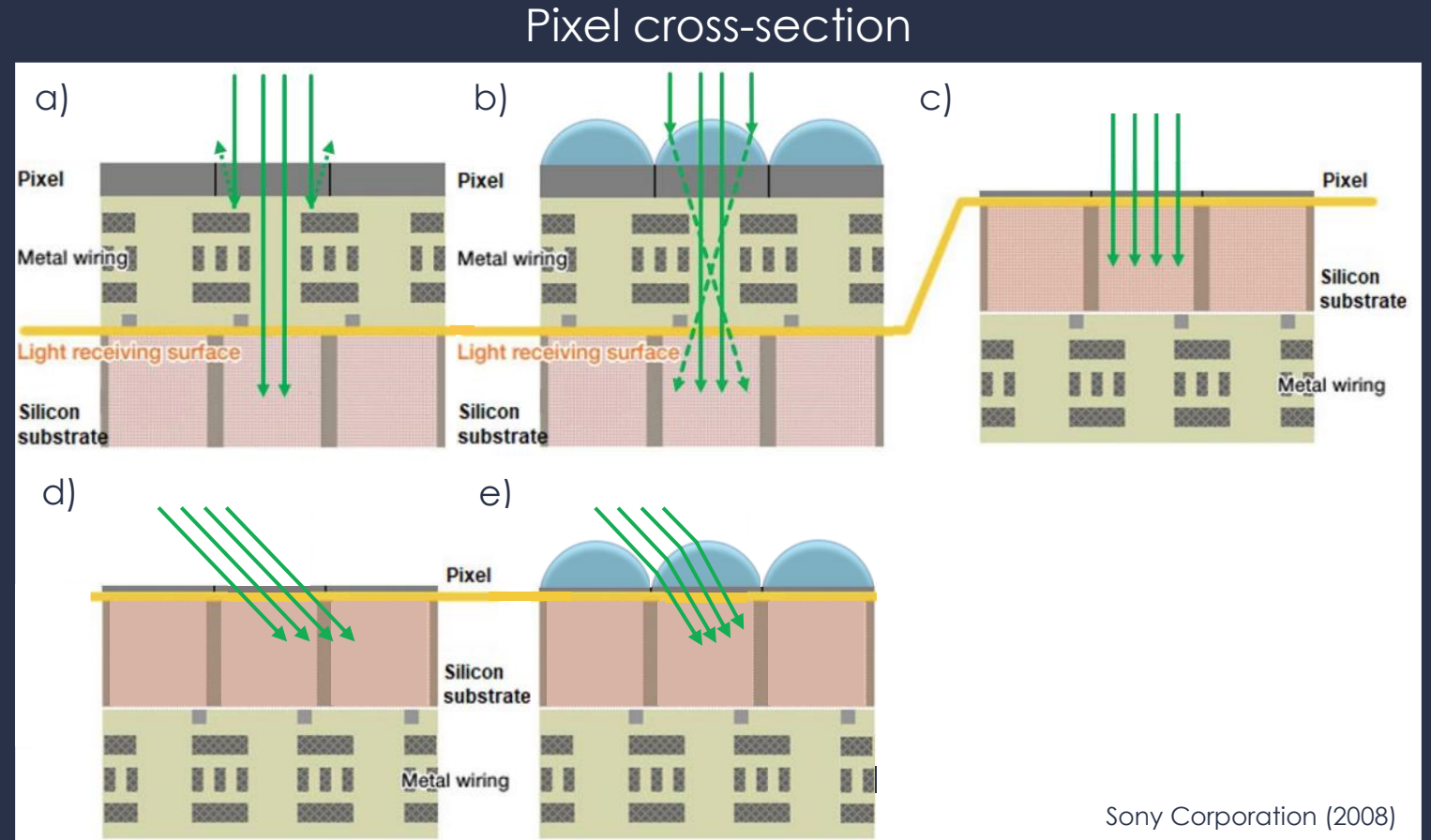
08.02.2021

Microlenses for imagers

- Front-illuminated image sensors a) without and b) with microlenses.

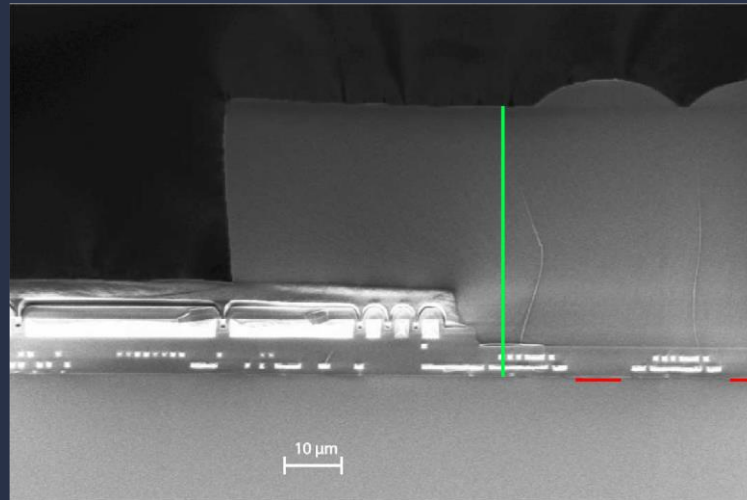
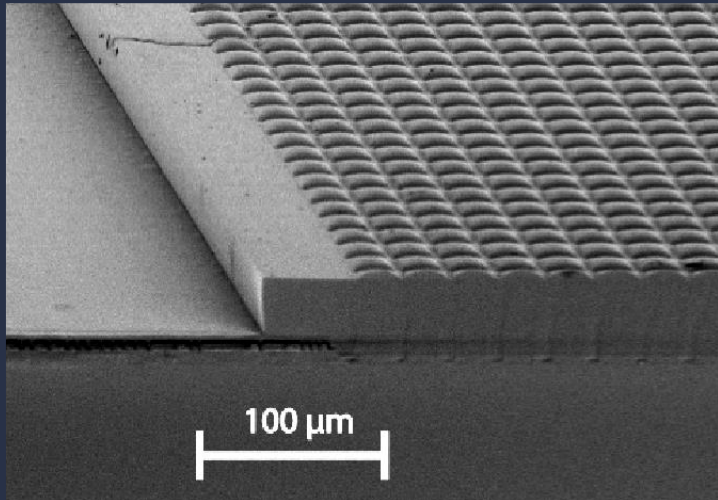
→ Maximize the light collection efficiency

- c) Difference between front- and back-illuminated image sensors (BI-CIS)
- d) and e) show how microlenses can decrease pixel crosstalk and increase MTF in BI-CIS.

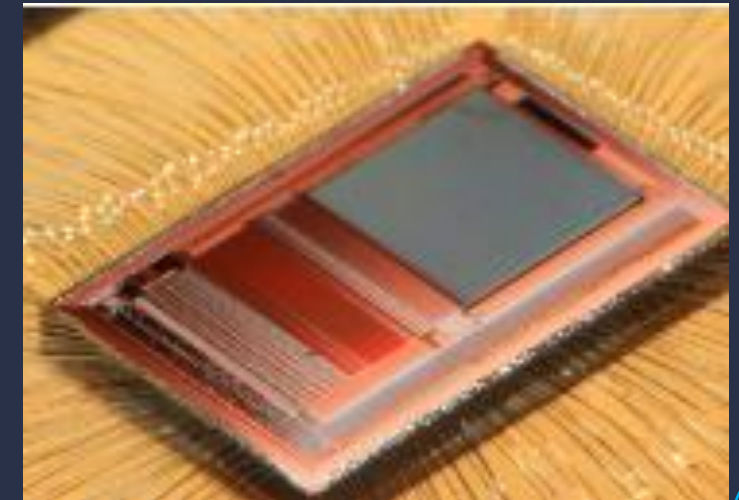


F. Zanella et al., Applied Optics, **59** (12), 3636-3644 (2020)

Prototyping / small-series production of UV-replicated microlenses



J. Mata Pavia et al., Optics Express **22**, 4202-4213 (2014)

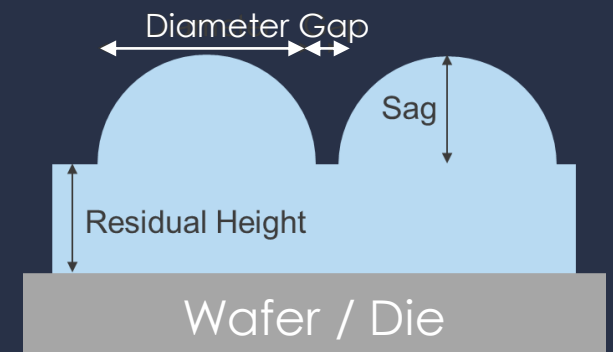


Key features

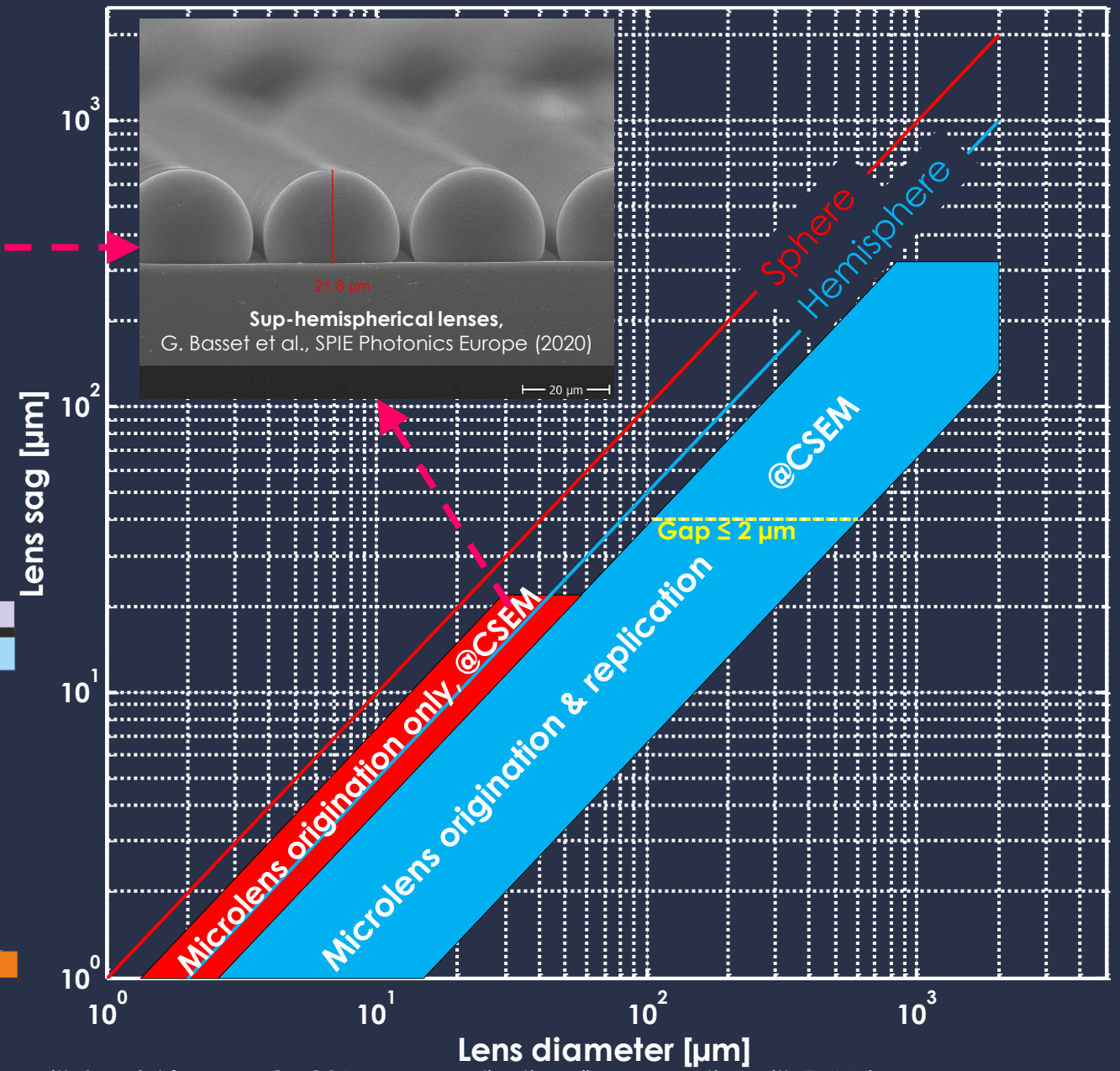
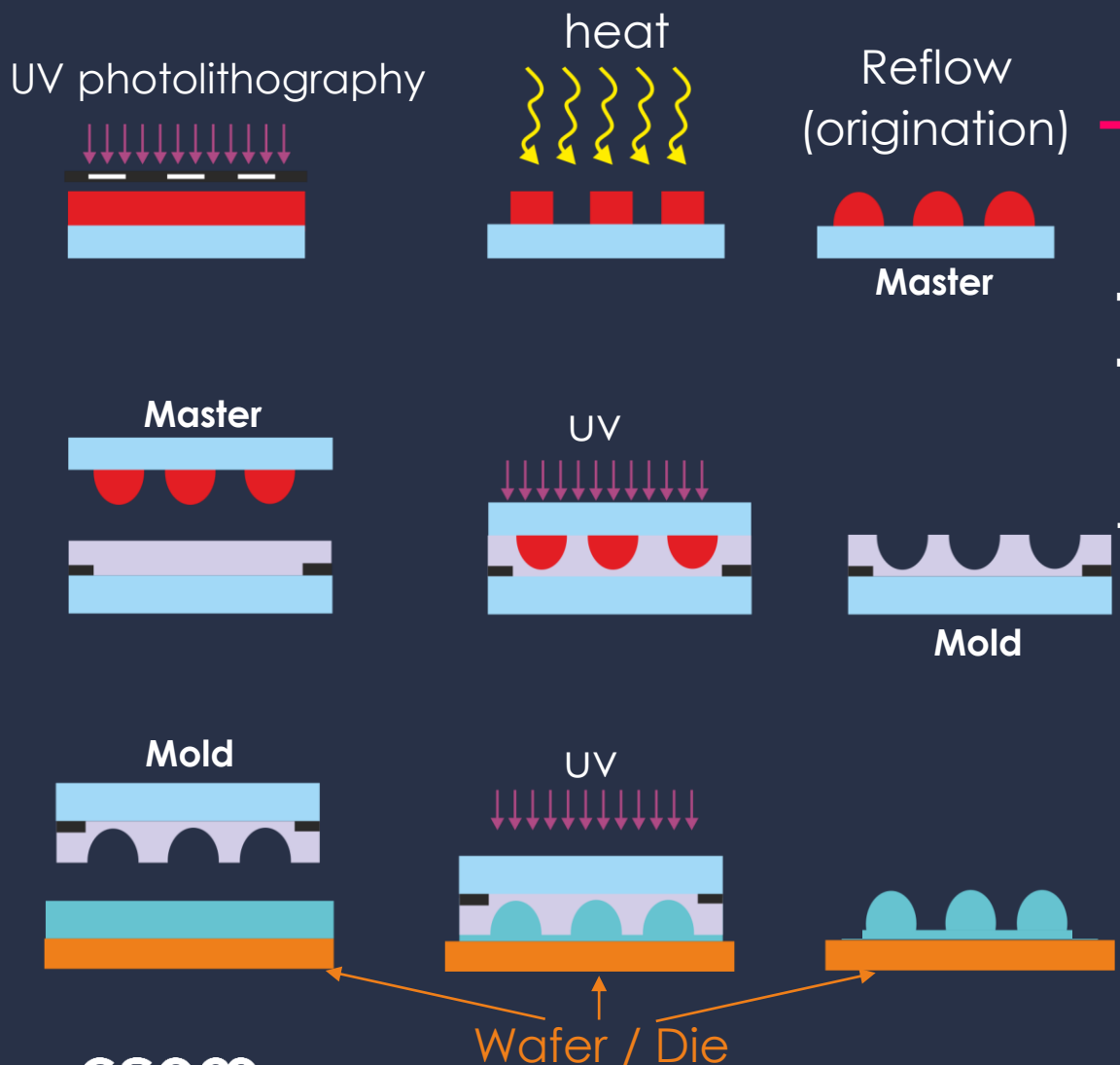
- Wafers up to 6", bare dies down to 2x2 mm² or packaged dies
- Various lens materials: Inorganic sol-gels, Organic: PMMA, PU
- Microlens Sag and diameter: From a few μm to mm
- Minimum residual height down to 10 μm (<4" wafer)
- <2 μm alignment accuracy for assembly

Applications

- Beam shaping of light sources: VCSEL, μLED
- Light concentrator for light sensor (photodiodes) or imagers (SPAD, CCD, CMOS)
- Super-resolution imaging



Capabilities



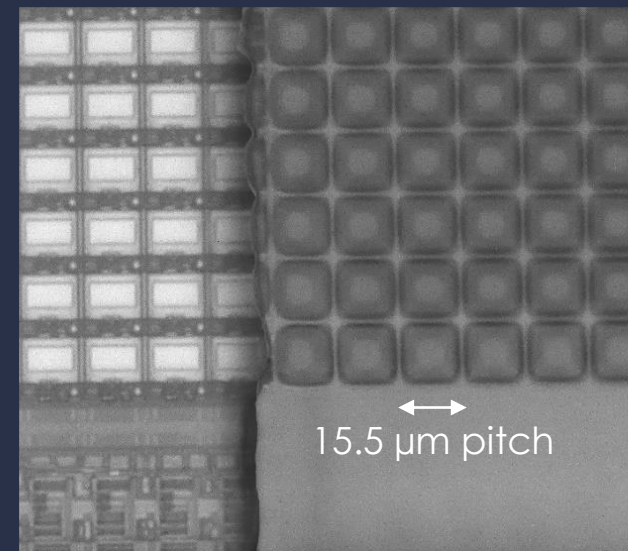
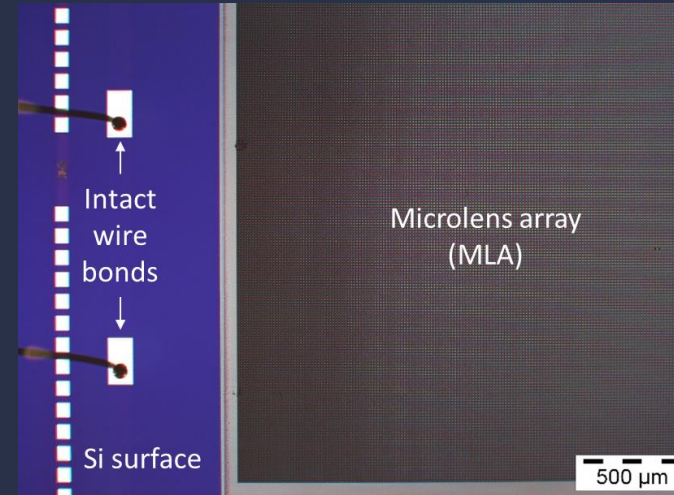
Microlenses for **space imagers**

Challenges:

- Processing of packaged (qualified) imager
- Lens/pixel alignment on BI-CIS
- BI-CIS performance improvement
- Space environment qualification of the microlens material

Pixel covered with	MTF	QE	1/PLS
Flat microlens material	0.577	83.1%	565
Microlens	0.594	85.7%	1043
Improvement	+0.017	+2.6%	×1.8

Processing of packaged BI-CIS:



Mechanical shocks & vibrations

Moisture

Thermal cycling, steps & life

Outgassing

Total ionisation dose (Y)

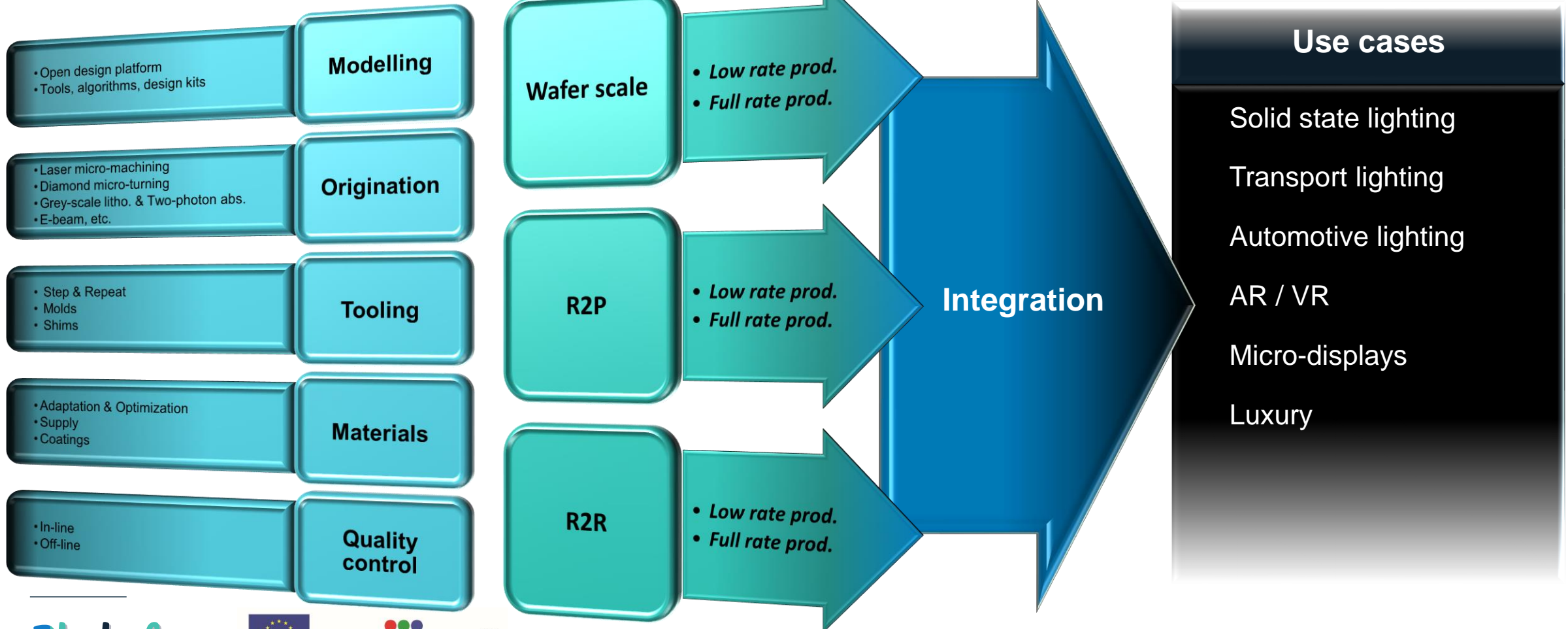
UV stability

PHABULOuS Pilot Line

Production Services & UV imprint manufacturing

Product integration

Technology validation



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