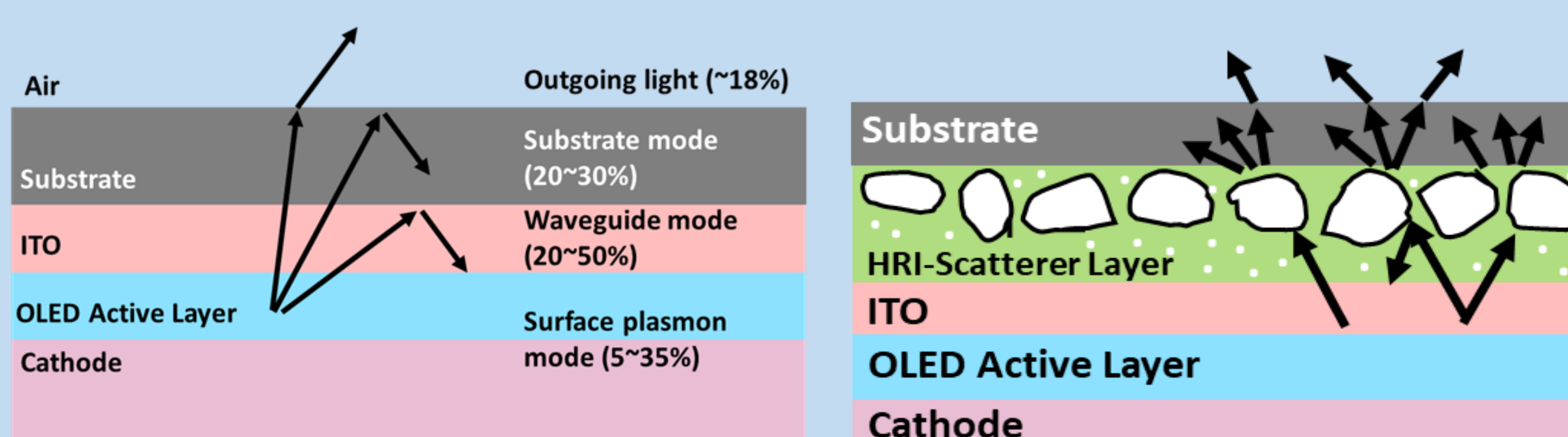


Project Objectives

To develop a *conformable* High Refractive Index – Internal Light extraction (HRI-LE) formulation product for OLED lighting panel manufacturers. The conformable HRI-LE will demonstrate at least 2.3X improvement in external quantum efficiency. This project is supported by DOE SBIR Phase II Grant# DE-SC0011295

Project Technology

- One major challenge for an OLED lighting device is its low light extraction efficacy which is only ~ 20%
- Light is lost at different interfaces within the device
- Incorporating an **Internal light extraction** can access ~ 80% of the light but requires a high quality HRI layer
- Pixelligent's proprietary high quality ZrO₂/Acrylic nanocomposite embedded with scatterers provides an ideal material system for the HRI layer



Light loss mechanism

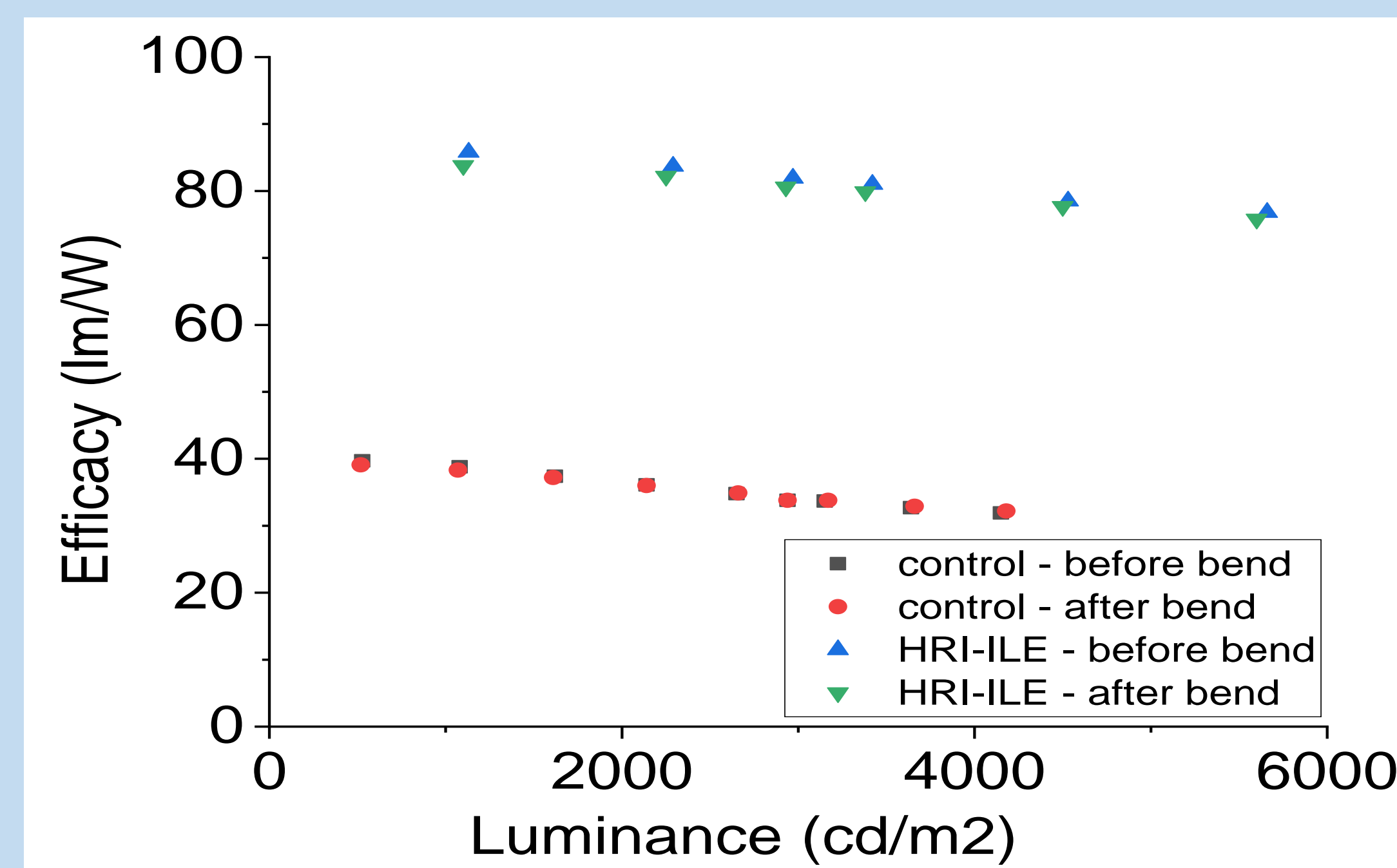
Pixelligent's ILE

Progress To Date

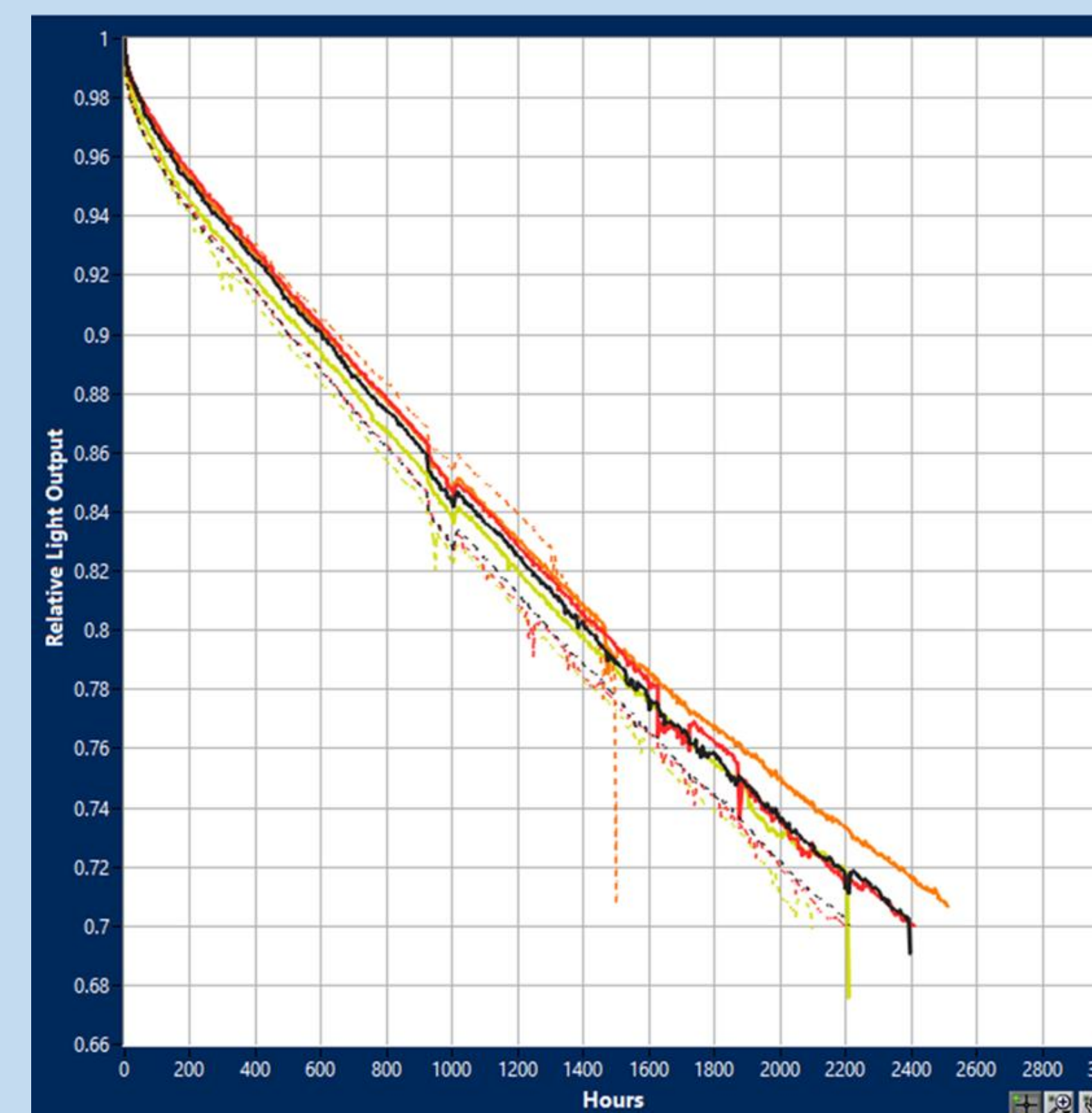
Phase I	Phase II	Phase IIB
HRI smoothing layer for ILE	HRI-ILE formulation with scatterers	Flexible HRI-ILE formulation with scatterers
2.19X EQE improvement	>2.5X EQE improvements	>2.3X EQE improvements
		LT70 equivalent to >50,000 hrs
		Demonstrated flexibility, 1x 50mm radius

Project Results

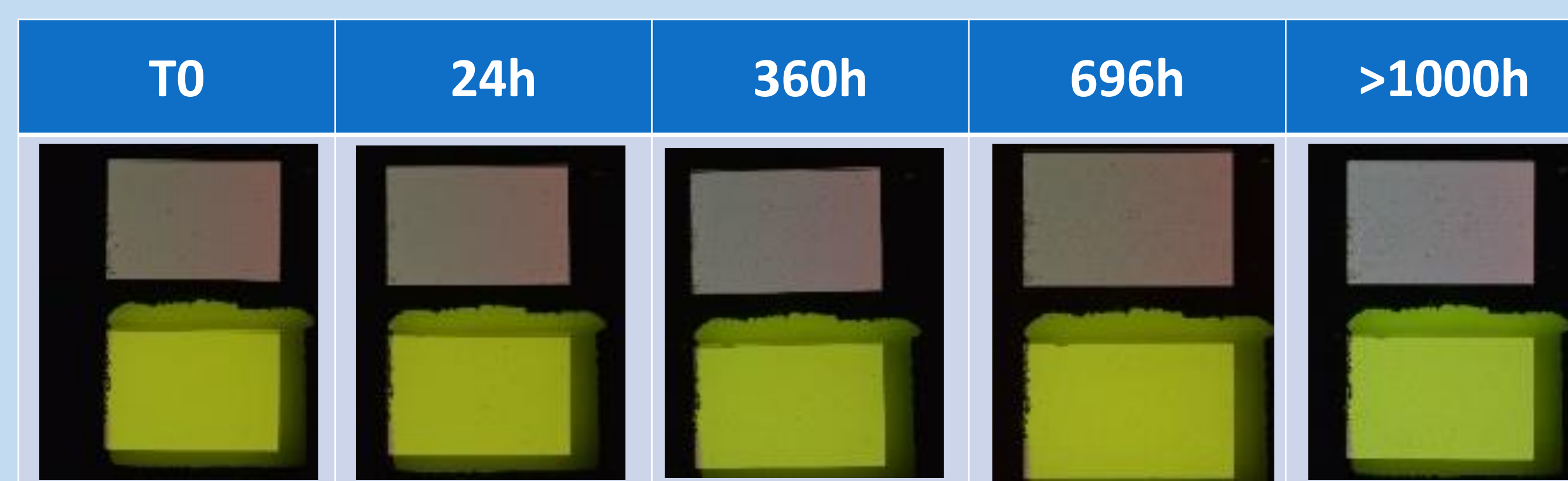
Efficacy of the integrated device before and after bend around 50 mm radius (1X)



LT70 of ~2400 hours at accelerated testing 10 mA/cm² (~20X acceleration factor at 3000 cd/m²)

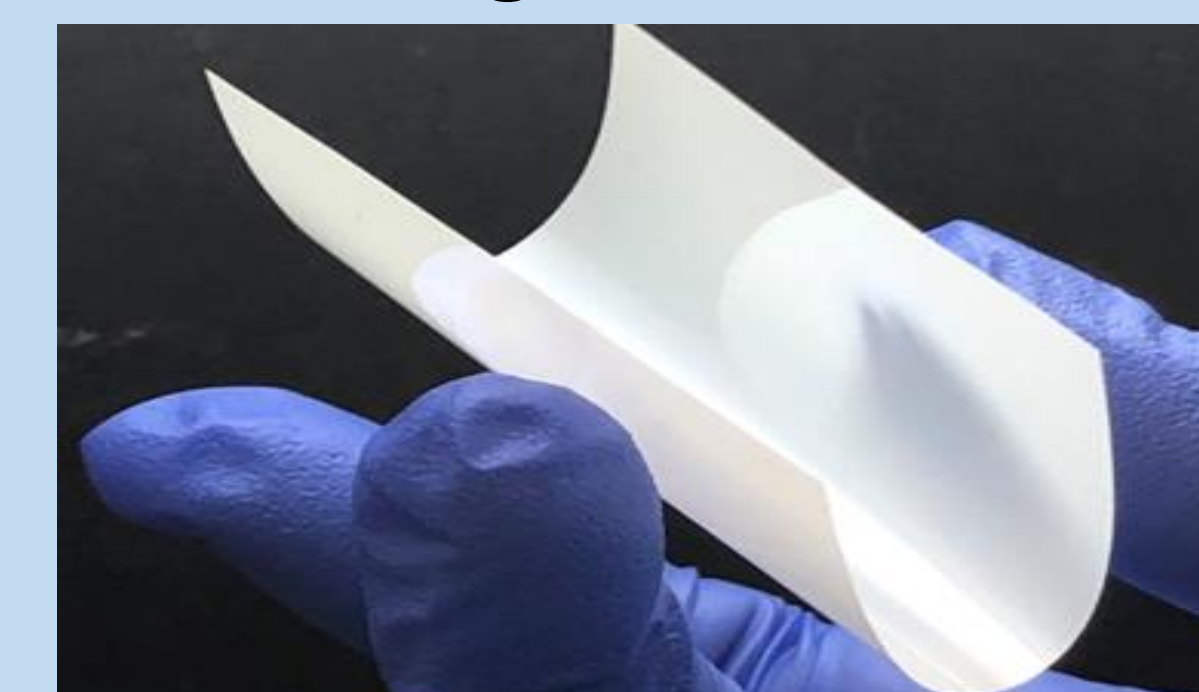
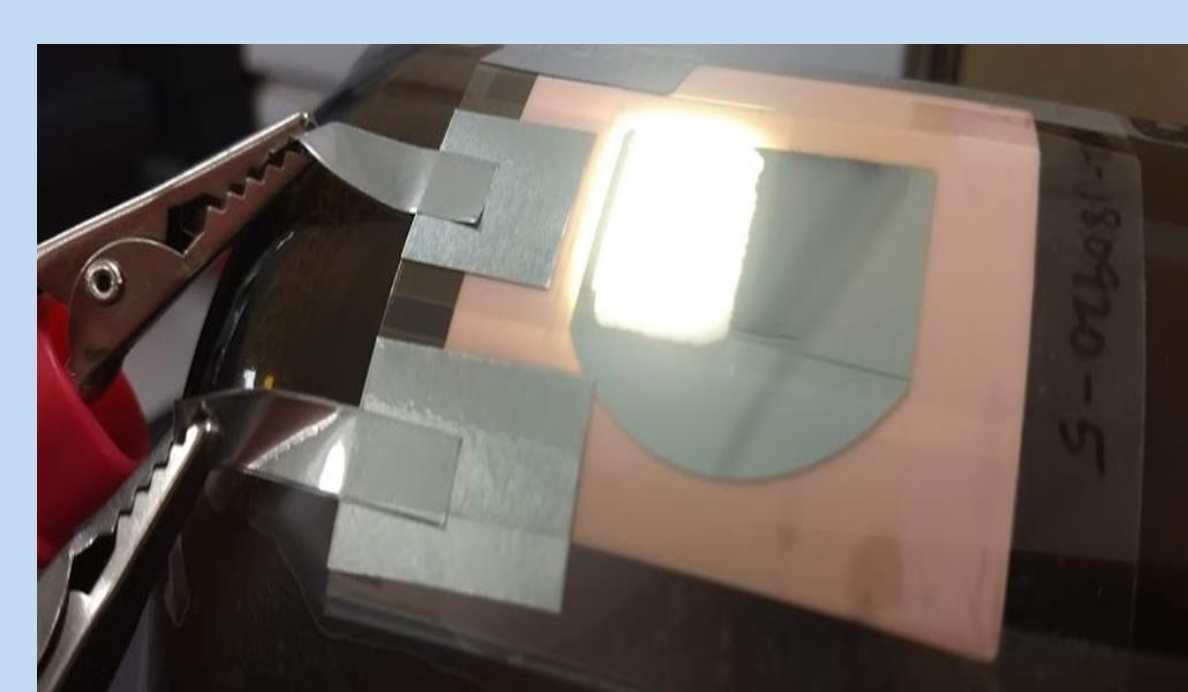


Passed 85C/85% testing



Functioning OLED device built on flexible substrate

HRI-LE film deposited on rigid substrate



Distribution of EQE improvement with HRI-ILE

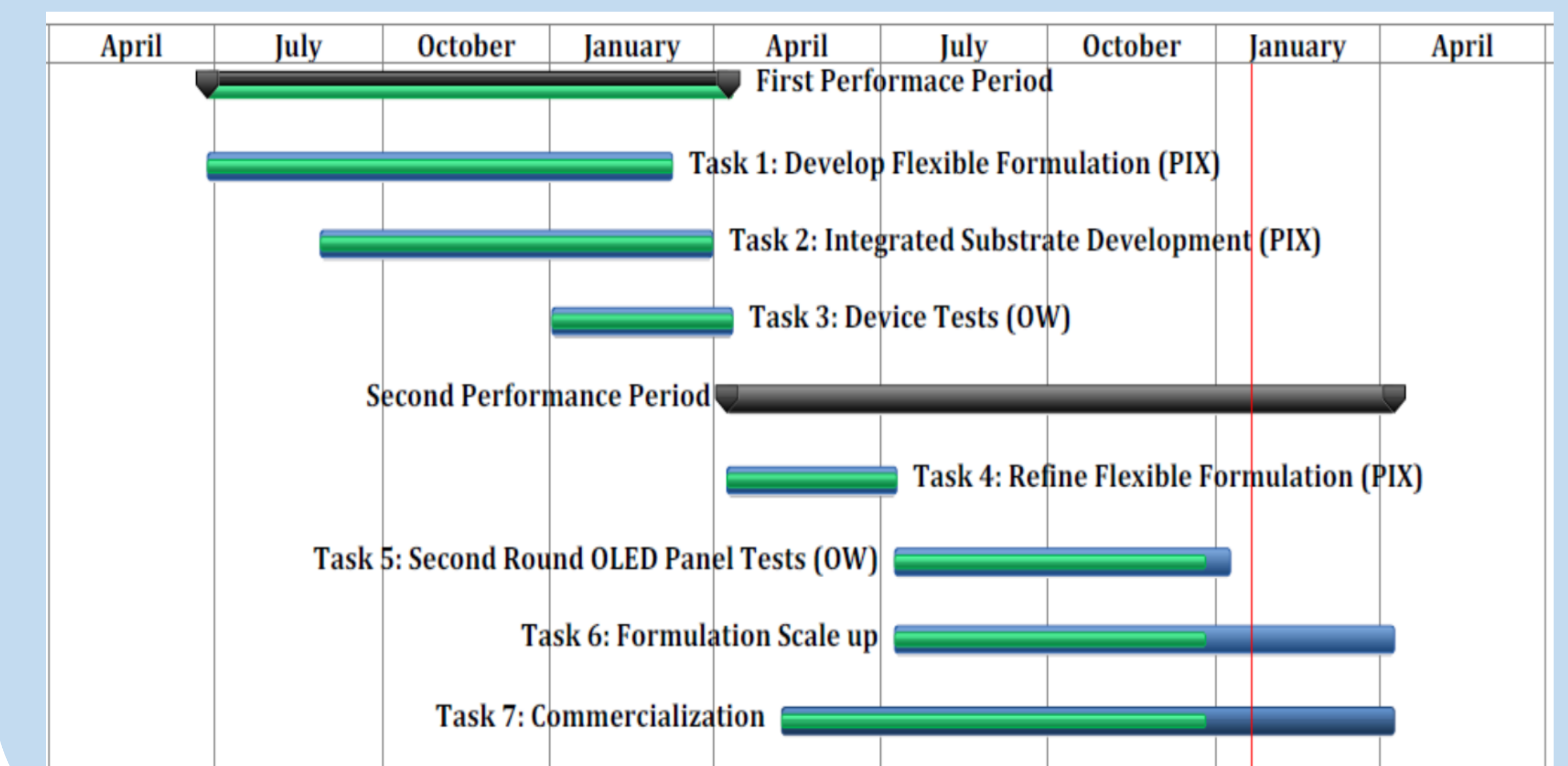


Project Results

Benefits of Pixelligent formulation and HRI-ILE

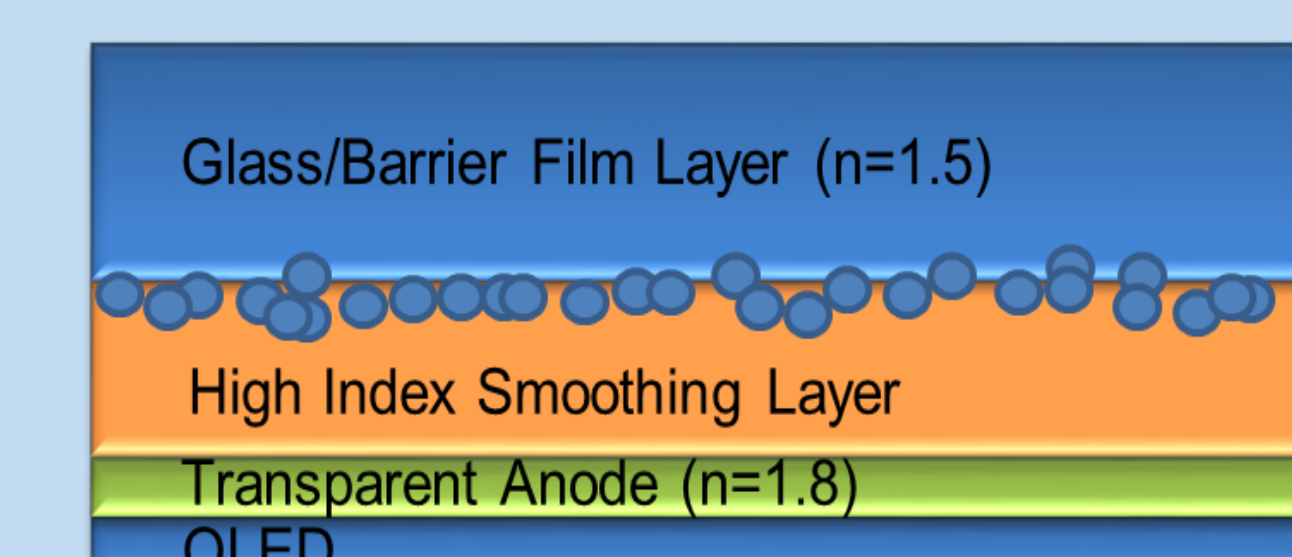
Formulation	HRI-ILE
High RI	High RI
High transparency	High transparency
Solution processable	Thermal stability
Low viscosity	Process stability
Process stability	Good Adhesion
Deposition process	Flexible

Project Progress (2017 – 2019)

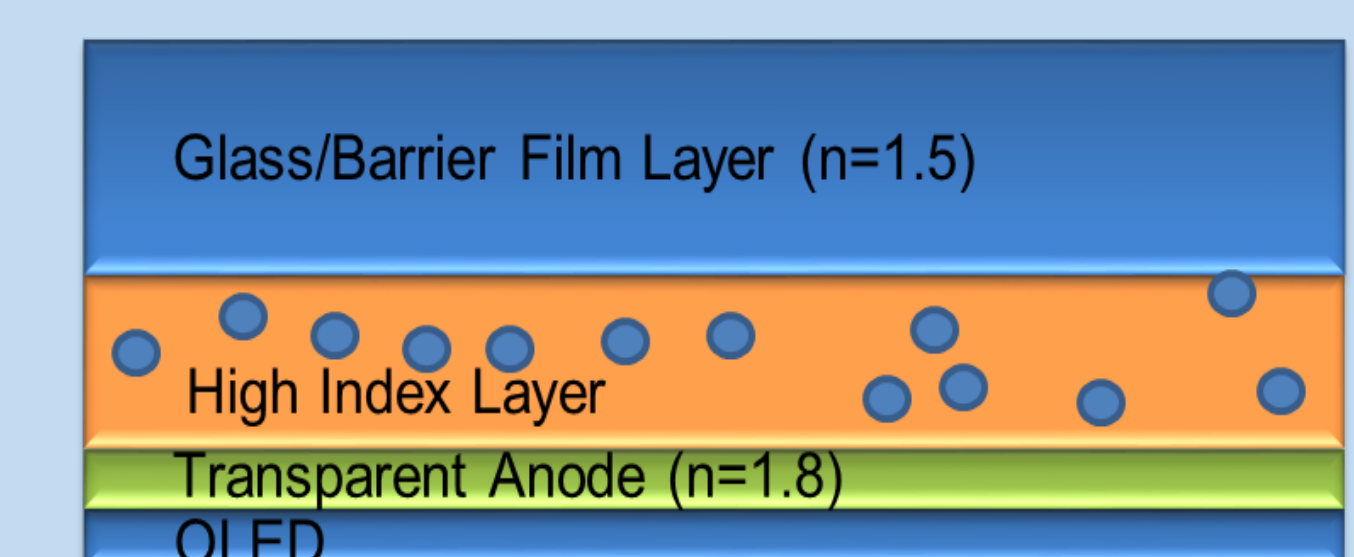


Technology Roadmap

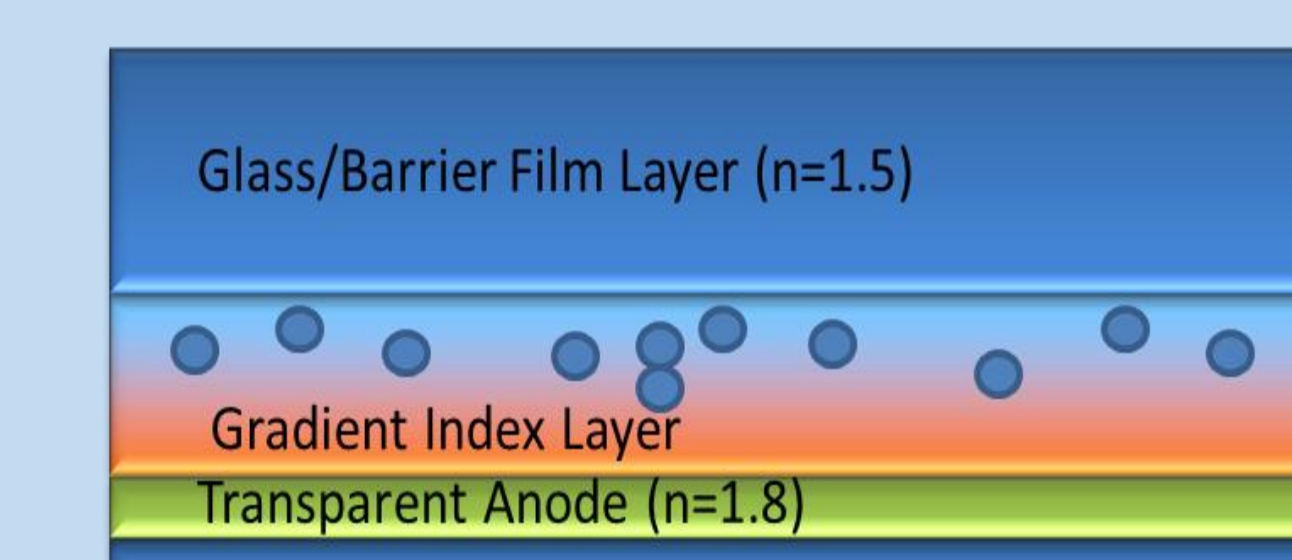
Pixelligent has shown feasibility of the following cost effective, easy to manufacture, and efficient light extraction technologies for OLED lighting



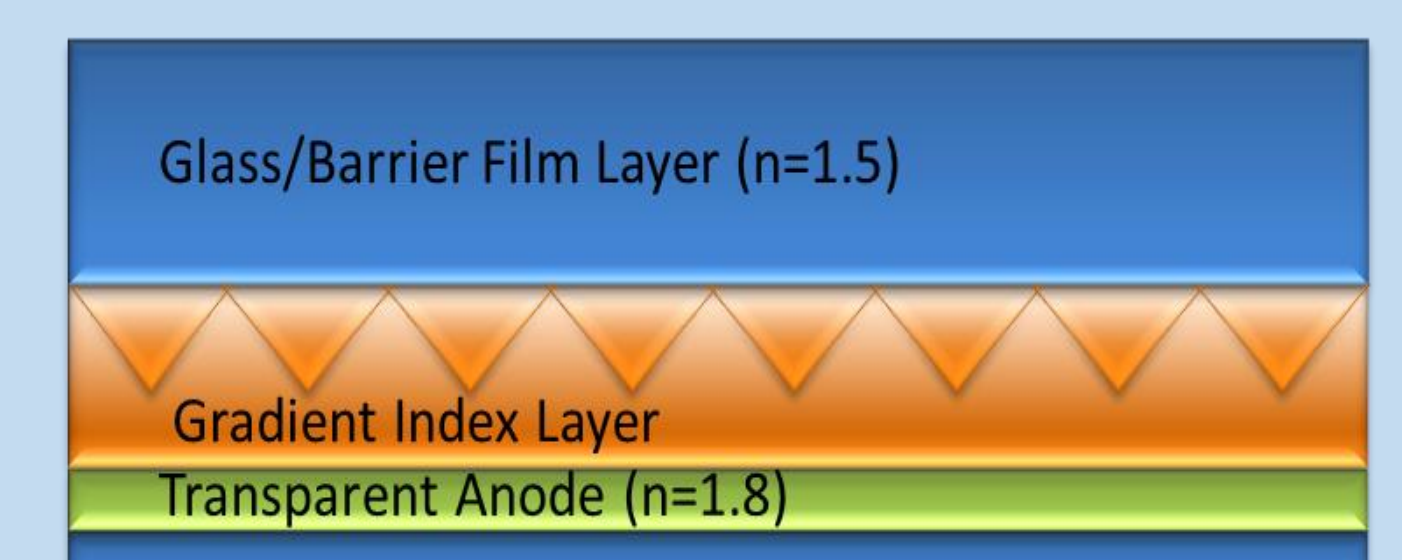
Gen 1
(Planarization of the scatterers)



Gen 2
(HRI-ILE with scatterers)



Gen 3
(Graded Index HRI-ILE)



Gen 4
(3D gradient)