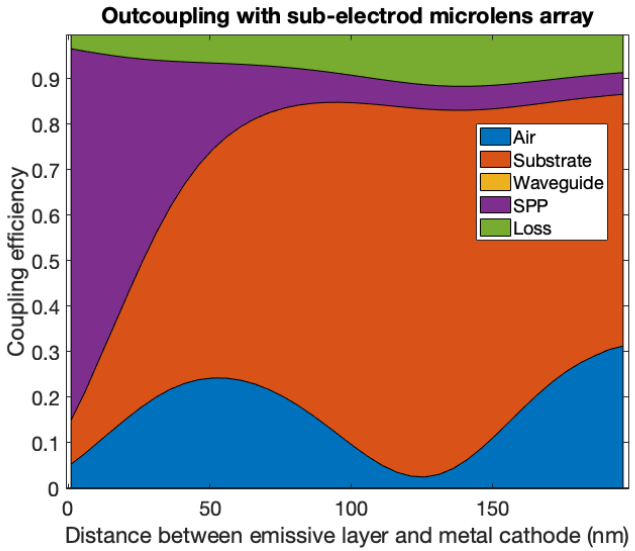
Improving substrate mode outcoupling in organic light emitting diodes

(a)



(b)

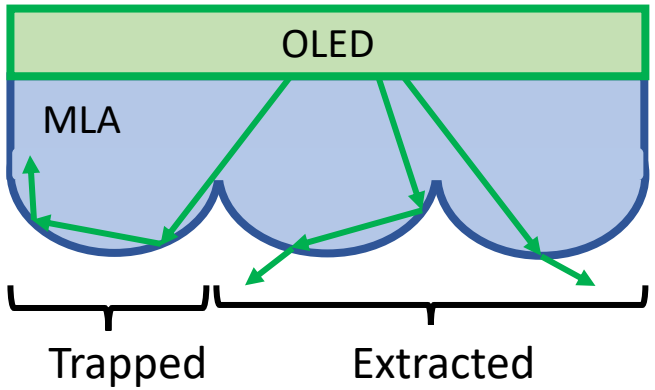


Figure: (a) Fraction of light coupled into the substrate mode of a green phosphorescent OLED. (b) Schematic of a typical microlens array outcoupling structure. Light is trapped due to the index mismatch between the microlens array and air.

Objective

➢ To improve OLED outcoupling efficiency by increasing the fraction of light coupled out of substrate modes

Impact

Despite the nearly 100% internal quantum efficiency efficiency achieved by phosphorescent OLEDs, external quantum efficiency is limited, primarily by light trapped in surface plasmon polariton, waveguide, and substrate modes. With the use of a sub-electrode microlens array, nearly 100% of waveguide modes can be coupled into substrate modes. However, the mismatch in the index of refraction of the device substrate (e.g. glass) and the operating environment (e.g. air) trap ~60% of emitted light in the substrate. Existing external outcoupling structures, such as a microlens array, can only extract ~60% of substrate modes. The goal of this work is to improve existing substrate mode outcoupling structures. By doing so, the device operating current will decrease, leading to extended lifetime as well as increased efficiency.

Facilities and Methods Used

- Vacuum Thermal Evaporation
- Atomic Layer Deposition
- Photolithography

Relevant Papers

- Qu, Y., et al., *ACS Photonics,* DOI: 10.1021/acsphotonics.8b00255

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