Light emission from thin film structures

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Liquid Crystals and Photonics

Overview

introduction
- outcoupling in 1D: geometrical optics

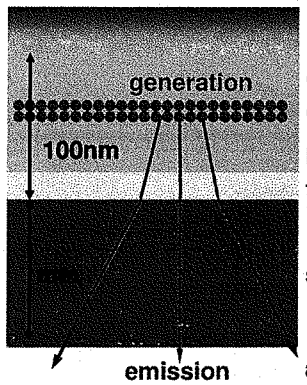
emission from microcavities
- outcoupling in 1D: OLED microcavities
- optimization of 1D OLED microcavities

emission from 3D structures
- structuring the substrate/air interface

applications: lighting versus displays

conclusions

Introduction: OLED optical structure

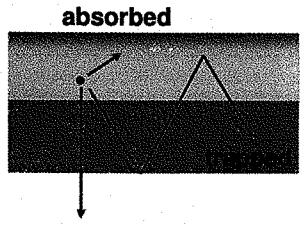


cathode (metallic)
electron transport layer
emitting layer
hole transport layer
transparent electrode ITO
substrate (n=1.5)
emission
air (n=1)

Introduction: outcoupling efficiency

outcoupling efficiency = emitted light / generated light

Generated light:
- absorbed light
- trapped light
- emitted light

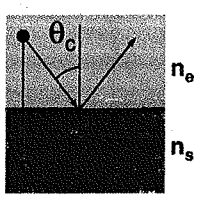


Outcoupling in 1D: geometrical optics

Total internal reflection
for $\theta > \theta_c$

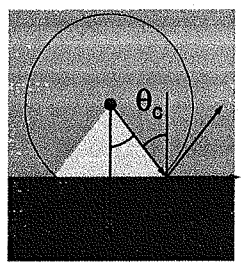
critical angle θ_c

$$\sin\theta_c = \frac{n_s}{n_e}$$



Outcoupling in 1D: geometrical optics

Coupling efficiency into the substrate



$$\eta = \frac{1}{2}(1-\cos\theta_c)$$
$$= \frac{1}{2}\left(1-\sqrt{1-\left(\frac{n_s}{n_e}\right)^2}\right)$$

for $n_e = 1.8$
for $n_s = 1.5$: $\eta = 22.4\%$