

Precise Control of Organic LED Emission Through Optically-Resonant Microcavity Confinement

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Introduction

OLED Devices

Waveguides and the Fabry-Pérot Etalon

Microcavity-confined OLEDs

Experimental Methods

Device Fabrication

Angle-Resolved Electroluminescence Spectroscopy

Results

Single Cavity Devices

Multi-cavity Devices

Conclusions

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Single Cavity Devices

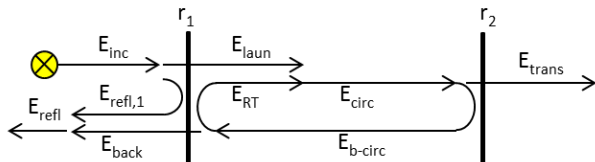
Multi-cavity Devices

Conclusions

OLED Devices

Waveguides

The Fabry-Pérot Etalon



$$T(\phi) = \frac{(1 - R_1)(1 - R_2)}{(1 - \sqrt{R_1 R_2})^2 + 4\sqrt{R_1 R_2} \sin^2(\phi)}$$

$$T_{\phi=0} = \frac{(1 - R_1)(1 - R_2)}{(1 - \sqrt{R_1 R_2})^2}$$

Microcavity-confined OLEDs



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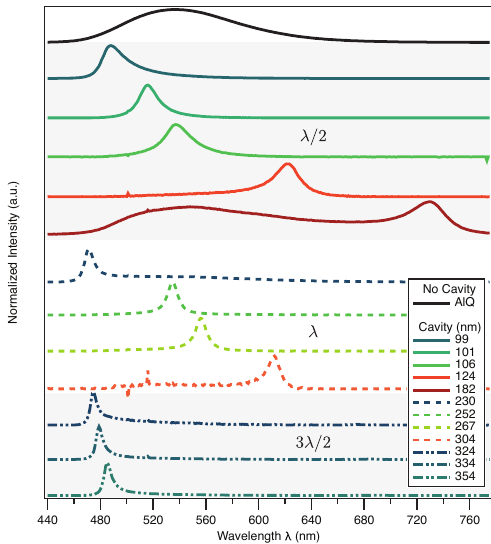
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Single Cavity Devices

Test



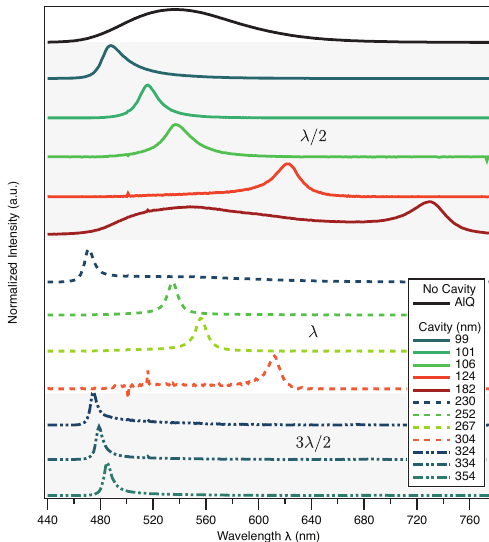
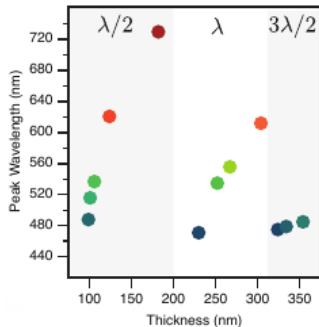
Peak Emission Wavelength

$$\lambda_0 = \frac{2nd}{q}$$

$n \rightarrow$ index of refraction

$d \rightarrow$ cavity thickness

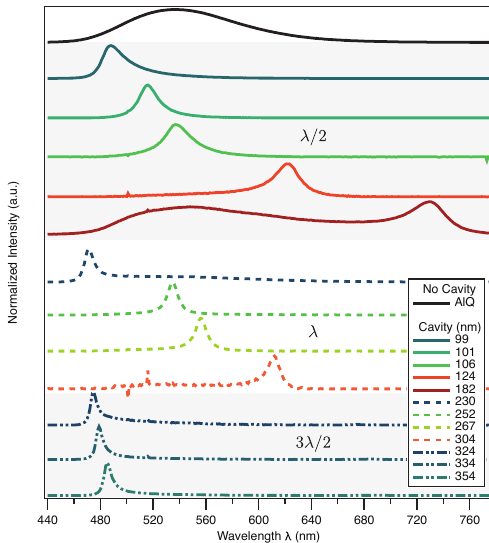
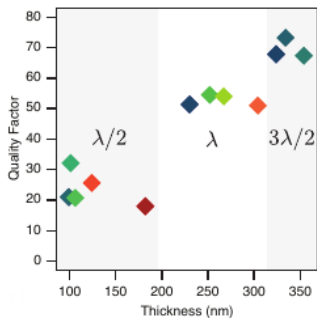
$q \rightarrow$ resonant mode



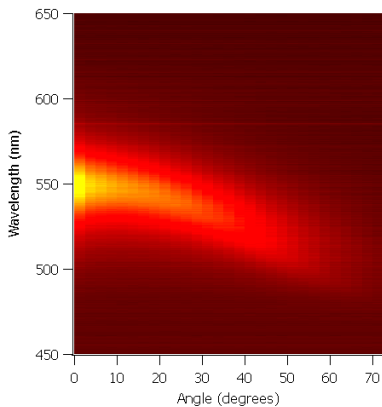
Band Narrowing

$$Q = \frac{2nd}{\lambda_0} \left\{ \frac{1 - \sqrt{R_1 R_2}}{\pi(R_1 R_2)^{1/4}} \right\}$$

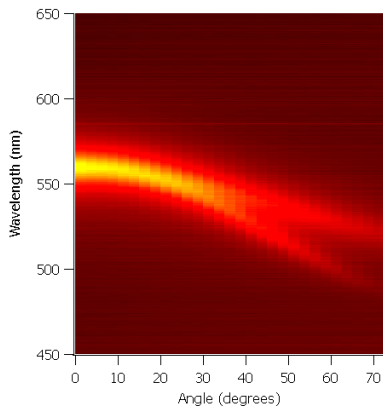
$$Q = q \left\{ \frac{1 - \sqrt{R_1 R_2}}{\pi(R_1 R_2)^{1/4}} \right\}$$



Effect of Bottom Electrode Material



Aluminum bottom electrode

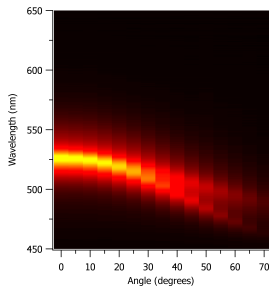


Silver bottom electrode

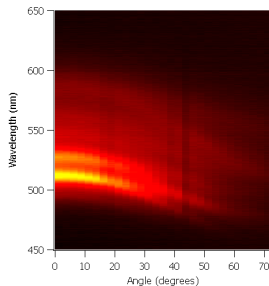
Multi-cavity Devices

Behavior at Large Angles

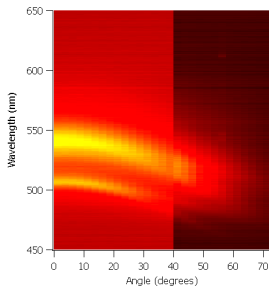
N=2 cavities



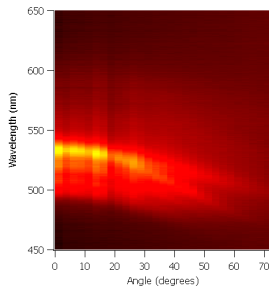
N=3 cavities



N=4 cavities

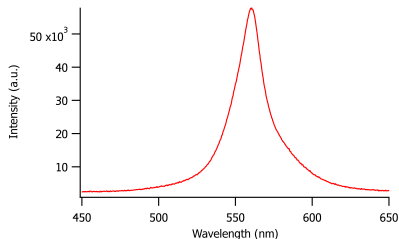


N=5 cavities

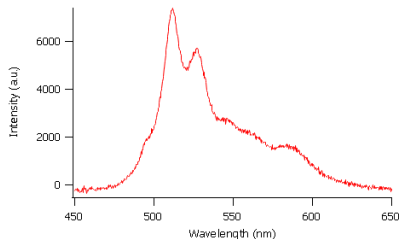


Number and Bandwidth of Resonant Modes

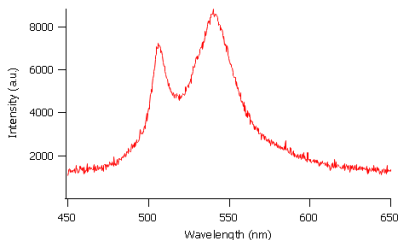
N=2 cavities



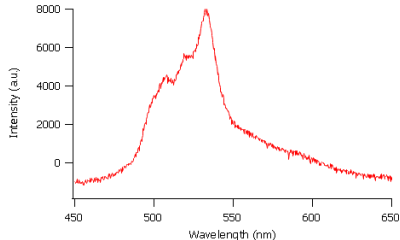
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Conclusions and Future Work

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Acknowledgements

Questions?



THE BEST THESIS DEFENSE IS A GOOD THESIS OFFENSE.

<https://xkcd.com/1403/>