

具專利價值之高效率藍色磷光有機發光二極體元件結構與母體材料開發及其光電物理特性研究

執行單位

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計畫主持人

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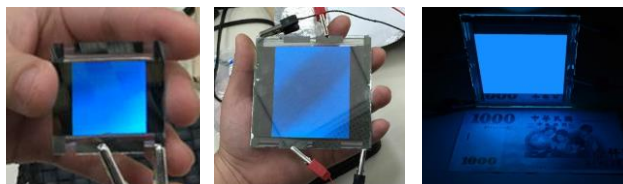
為開發出多款高效率且具穩定性之藍色磷光有機材料、在未施加任何取光機制下，出光效率可大幅提升至EQE~30%、大面積 $5 \times 5 \text{ cm}^2$ ，以及出光增益可達60%以上之光耦合微結構製程開發、並設計元件優化條件之電腦軟體一套。

- ✓ 103-105年度申請專利共計14件。(中華民國10件、美國4件)
- ✓ 已核准獲證6件。(中華民國5件、美國1件)

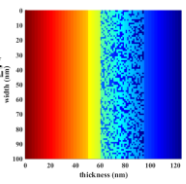
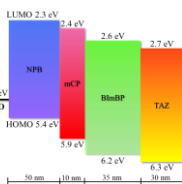
	第一年目標	第二年目標	第三年目標	
有機母體材料開發	3	3	3	15
藍光OLED效率表現	26%EQE	28%EQE	30%EQE	>30%
藍光壽命延長	1.5×	2×	4×	6×
外部光萃取增益	40%	50%	60%	70%
數值模擬軟體開發	1D	2D	3D	Reality

項次	專利申請號	申請日	專利獲准號	獲准日
1	P28030002US		na	na
2	P28030002TW		I510482	2015/12/1
3	101144650	2012/11/29	I503968	2015/10/11
4	14/309,900	2014/6/20	na	na
5	103106222	2014/2/25	I507403	2015/11/11
6	201510158919.8	2015/3/5	na	na
7	201510158326.1	2015/3/19	na	na
8	104140605	2015/12/3	I564298	2017/1/1
9	14/983,850	2015/12/31	na	na
10	104140798	2015/12/4	na	na
11	14/986,359	2015/12/31	na	na
12	105124683	2016/8/3	na	na
13	105139531	2016/11/30	I609864	2018/1/1
14	105135777	2016/11/3	I589673	2017/7/1

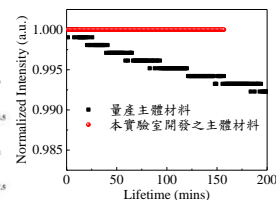
OLED大尺寸



多維度OLED
模擬軟體



商用系統下
元件壽命之表現



在本計畫中，我們將合成新型的藍色磷光發光層有機材料。我們計畫中一個獨特之處，為建立一套專為有機發光二極體設計的光電模型，由基本的固態元件物理方程式出發，推導出電流、電壓、亮度及頻譜等特性。最後，透過對於藍色磷光有機材料的物理特性探討，可以對於元件效率及壽命有進一步的瞭解，從而優化元件，此外，這部分的工作亦可以提供理論計算所需的物理參數。藉由各子計畫的合作，不但可製作出高品質的有機發光二極體，更可以建立一套設計規則，配合研究團隊的豐富業界經驗，將可提供產業界一個完整的解決方案。

Optoelectrical characterization for patentable host materials and device structures of high efficiency blue phosphorescent organic light-emitting diode

Execution Unit

Yuan Ze University

Project Director

Professor Tien-Lung Chiu, Ph.D.

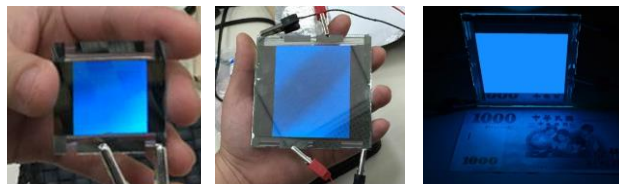
Several new organic materials will be synthesized as the emitting layer of the blue phosphorescent OLED with high efficiency achieving 30%EQE, large scale 5×5 cm². In addition, a simulation software was developed for OLED behaviors.

- ✓ 103–105, finished 14 patent applications, including 10 Taiwan and 4 USA.
- ✓ 6 Approved patents, including 5 Taiwan and 1 USA.

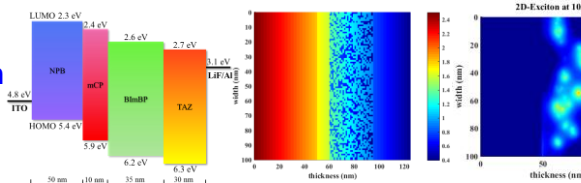
Year	1st	2nd	3rd	
Material	3	3	3	15
Efficiency	26%EQE	28%EQE	30%EQE	>30%
Lifetime	1.5×	2×	4×	6×
Gain	40%	50%	60%	70%
Software	1D	2D	3D	Reality

#	Application No.	Appl. Date	Approved No.	Approved Date
1	P28030002US		na	na
2	P28030002TW		I510482	2015/12/1
3	101144650	2012/11/29	I503968	2015/10/11
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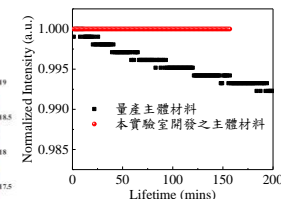
Large OLED



Simulation software



Lifetime



we will synthesize new organic materials as the emitting layer of the blue phosphorescent OLED. One unique feature of this project is that we will establish an electrical and optical model, based on first principle equations in solid-state device physics, to simulate the OLED characteristics such as current, voltage, luminance, and spectra. Finally, by measuring the physical parameters of organic materials for blue phosphorescent OLED, we will have deeper understanding of the device characteristics and we can further optimize the device performances, such as efficiency and lifetime. Besides, it also provides the inputs for the simulation program. With the positive feedback of the iteration of: synthesizing new materials --> fabricating substrates and devices --> measuring physical parameters --> constructing simulation model --> synthesizing new materials, we will not only fabricate a high quality blue phosphorescent OLED, but also establish a design rule. With the profound knowledge in industry of PI and co-PIs, we will provide a total solution of blue phosphorescent OLED to industry.