SPIC 2022 : Quatrième congrès national Sciences et Technologies des systèmes pi-conjugués
5-8 déc. 2022, Saint Malo 35407 (France)

Simplified Green-emitting Single-Layer Phosphorescent Organic light-emitting diodes with an external quantum efficiency > 22%

Fabien Lucas,[1,*] Clement Brouillac,[2] Sadiara Fall,[3] Nicolas Zimmerman, [3] Denis Tondelier,[1] Bernard Geffroy,[1,4] Nicolas Leclerc,[5] Thomas Heiser,[3] Christophe Lebreton,[6] Emmanuel Jacques, [6] Cassandre Quinton,[2] Joëlle Rault-Berthelot,[2] and Cyril Poriel[2]

[1] *LPICM, UMR CNRS 7647, Ecole Polytechnique, Institut Polytechnique de Paris, route de Saclay, 91128 Palaiseau, France*

[2] *Univ Rennes, CNRS, ISCR-UMR CNRS 6226, F-35000 Rennes, France*

[3] *Laboratoire ICube, Université de Strasbourg, UMR CNRS 7357, 67087 Strasbourg, France*

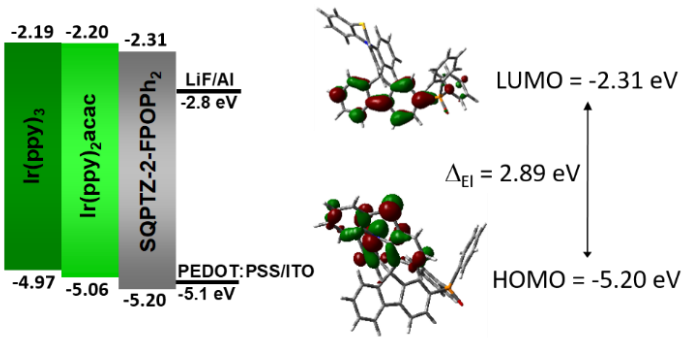
[4] *Université Paris-Saclay, CEA, CNRS, NIMBE, LICSEN, 91191, Gif-sur-Yvette, France*

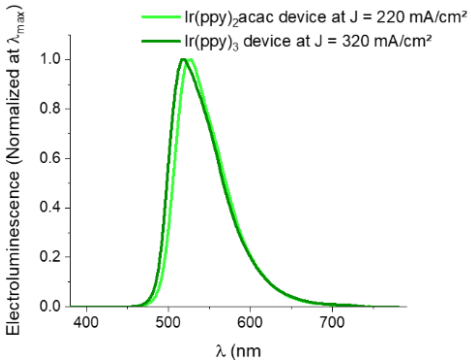
[5] *Institut de Chimie et Procédés pour l'Énergie, l'Environnement et la Santé (ICPEES), UMR CNRS 7515, 67087 Strasbourg, France.*

[6] *Univ Rennes, CNRS, IETR-UMR 6164, F-35000 Rennes, France*

*Fabien.lucas@polytechnique.edu

The development of new π-conjugated systems has led to the emergence of new devices such as organic light-emitting diodes (OLEDs), which are the cornerstone of next-generation display screens. In these display screens, pixels fabricated from phosphorescent OLEDs (PhOLEDs)[1] are multilayer architectures composed of injection, transport, blocking and emissive layers (EML). In order to develop a more virtuous technology (more sustainable and less expensive), simplification of the devices architecture is mandatory. The ideal devices are the single-layer PhOLEDs (SL-PhOLEDs), with a very simple stack only constituted of the electrodes and the EML. These devices can hence significantly decrease their environmental footprint and cost. Nevertheless, removing the functional layers of an OLED drastically decreases the performances and there is, so far, only a few examples of high-performance SL-PhOLEDs.[2,3,4] Thus, in SL-PhOLEDs, the role of the functional layer should be performed by the EML and more precisely by the organic semi-conductor (OSC), which should allow an excellent injection/transport/recombination of charges. In this work, thanks to a rational design of the OSC, we report a green-emitting SL-PhOLED, displaying a very high external quantum efficiency of 22.7%. This performance is, to the best of our knowledge, the highest reported for SL-PhOLEDs (all colours considered). The EML of this device is constructed on the barely studied $Ir(ppy)_2acac$ phosphor and a high efficiency host material possessing a Donor-spiro-Acceptor design obtained through a quick and efficient synthesis route. Through a structure/property/device performance relationship study combining morphological (AFM), photophysical (time-resolved spectroscopy) and charge transport studies, we show that the EML presents all the required characteristics such as smooth surface, quick radiative deactivation, and ambipolarity.





[1] Baldo, *et al.*, *Nature* **1998,** *395* (6698), 151-154.
[2] Lucas, *et al.*, *J. Mater. Chem. C* **2020,** *8* (46), 16354-16367.
[3] Hsu, *et al.*, *Org. Electron.* **2014,** *15* (11), 3327-3332.
[4] Yoshii, *et al.*, *Chem. Asian J.* **2020,** *15* (14), 2181-2186.