COLOR TUNING OF BLUE AND WHITE OLEDS THROUGH EXCIPLEX STATES WITH ONE SINGLE EMISSIVE LAYER

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- **Abstract**: **In this work, the tuning from blue or white emission from a single emitting layer OLED is reported. The tuning was through different exciplex states in devices whit the following architecture ITO / PEDOT: PSS / CZDD / BPhen / Ca-Ag. For the mentioned architecture, the absence of electron transport layer (ETL) BPhen generate a blue emission. In this architecture without BPhen by decreasing the thickness of PEDOT: PSS several blue tonalities were achieved, the wavelength of maximum emission ran from 430 to 550 nm and CIE coordinates changed from (0.20, 0.22) to (0.26, 0.45). For the architecture with ETL white emission was observed due to the exciplexes states induced at CZDD/BPhen interface, emitting at longer wavelengths giving the complementary emission for white light. For this architecture the changing of PEDOT:PSS let us the tuning of the emission from cold to warm white: the luminous efficacy and current efficiency for blue emission were of 5.2 lm/W and 6 meanwhile for white emission were 6.8 lm/W and 9, respectively.**

INTRODUCTION

White organic light emitting diodes (WOLEDs) are an alternative for lighting which could be competitive with inorganic LEDs because they can be fabricated at lower cost, might generate superior white color balance and can be flexible [1]

RAPID EFFICIENCY INCREASE IN WOLEDs

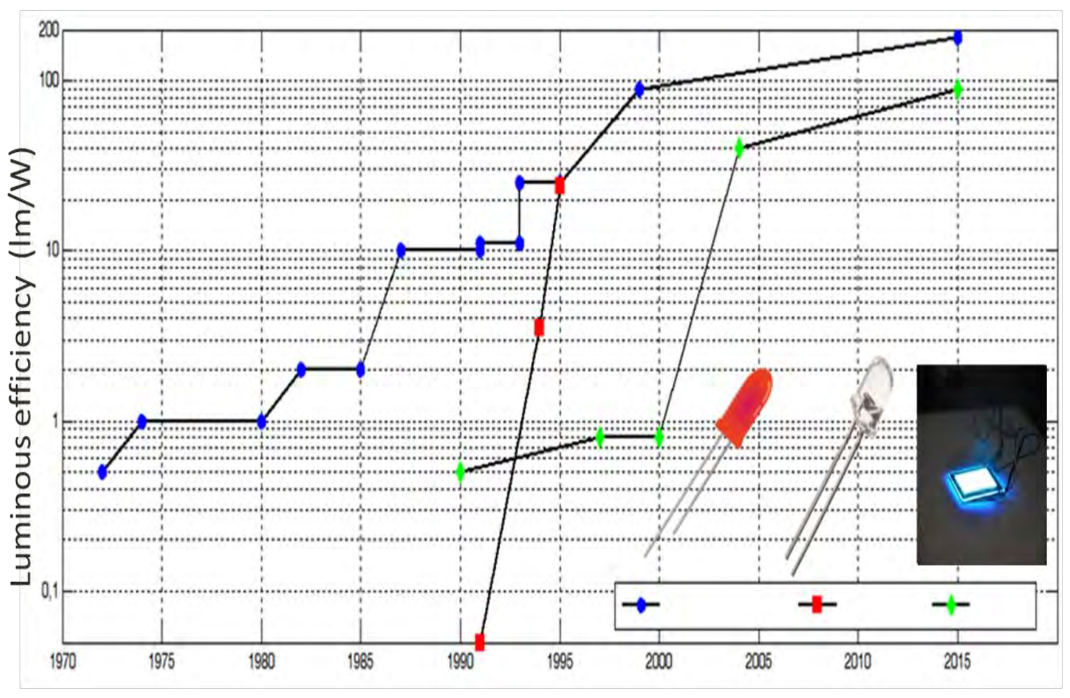

Fig 1. Rapid growth of efficiency in WOLED compared to inorganic LEDs.

WOLEDs can generate ideal warm white light for some applications, which can hardly be obtained with other lighting technologies.

WHITE LIGHT EMISSION SPECTRA

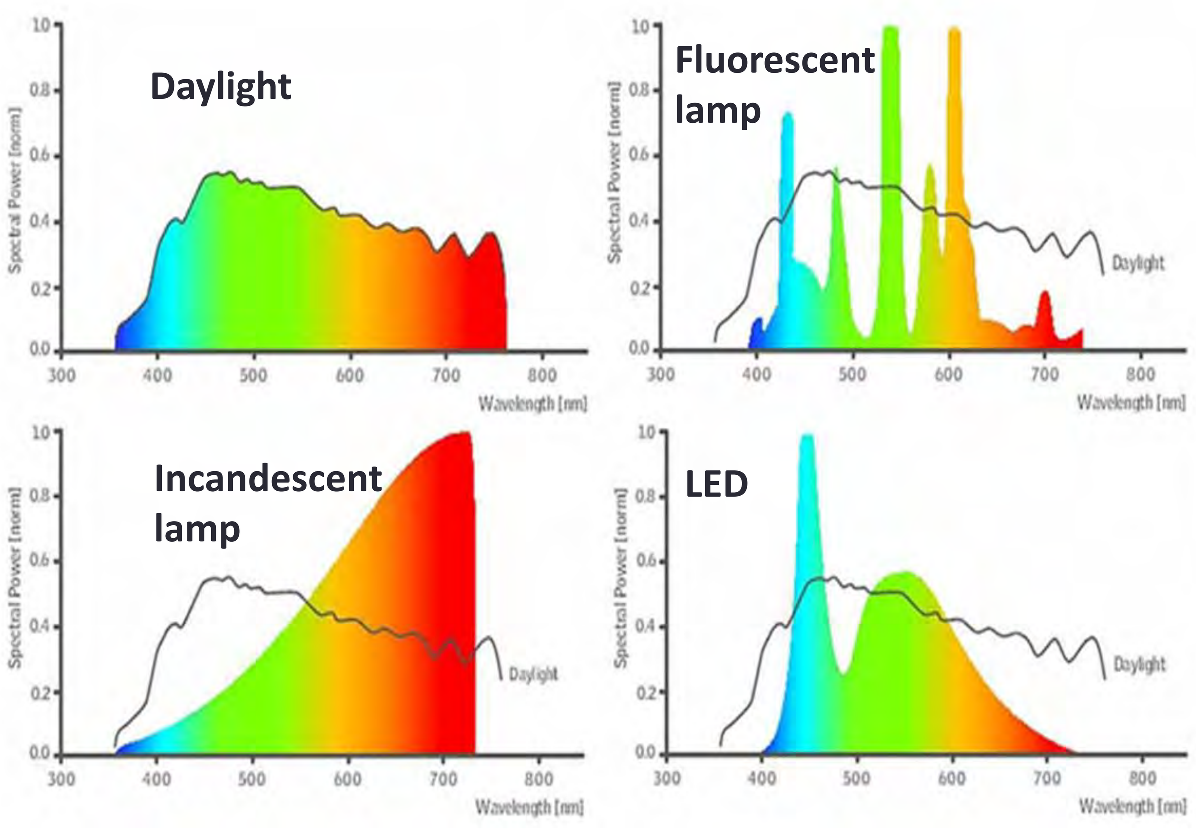

Fig 2. Emission spectra for different lighting sources

DESIGN OF THE DEVICES.

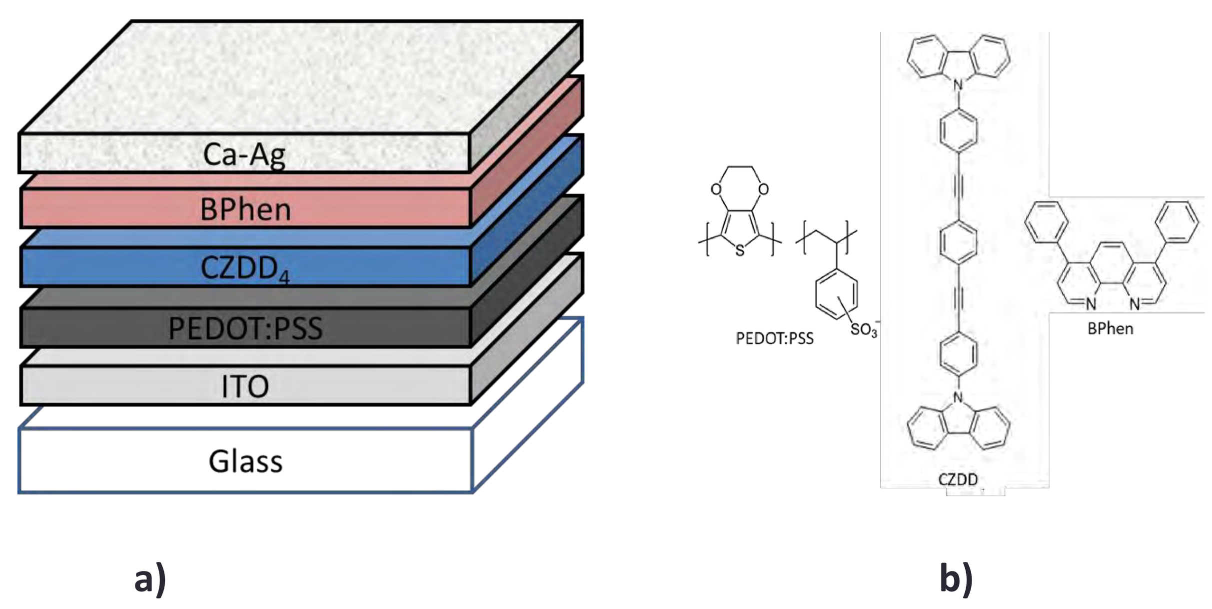

Fig.3. (a) Schematic architecture of the fabricated WOLEDs device. (b) Chemical structures of organic materials used.

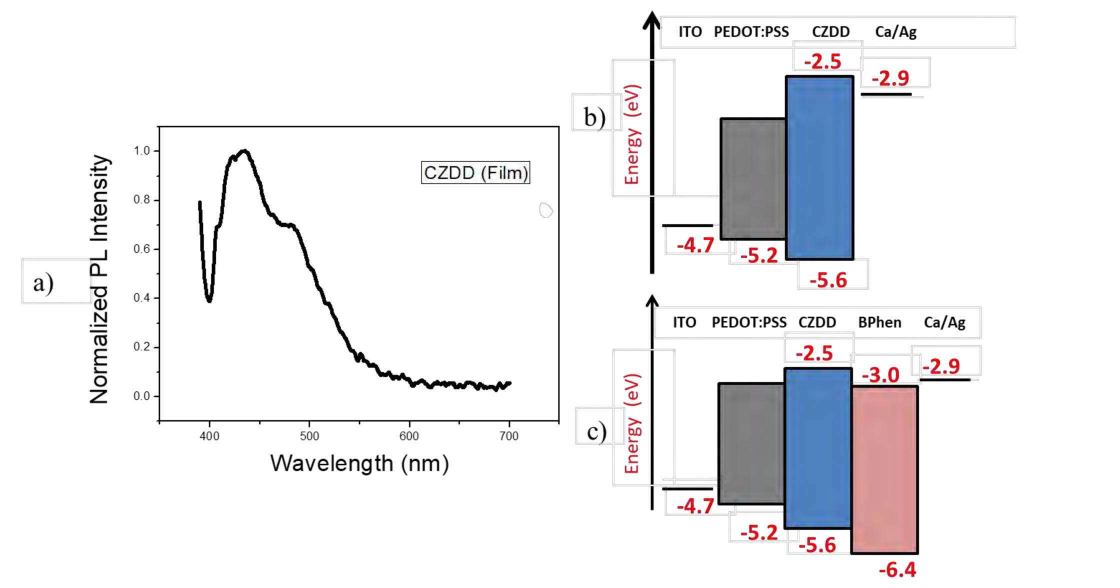

Fig.4. (a) Normalized PL spectrum of the CZDD material. Energy levels diagram for (b) OLED-1 and (c) OLED-2; the energy band gap of CZDD is 3.1 eV with LUMO and HOMO (measured by cyclic voltammetry) levels at -2.5 and -5.6 eV, respectively.

RESULTS

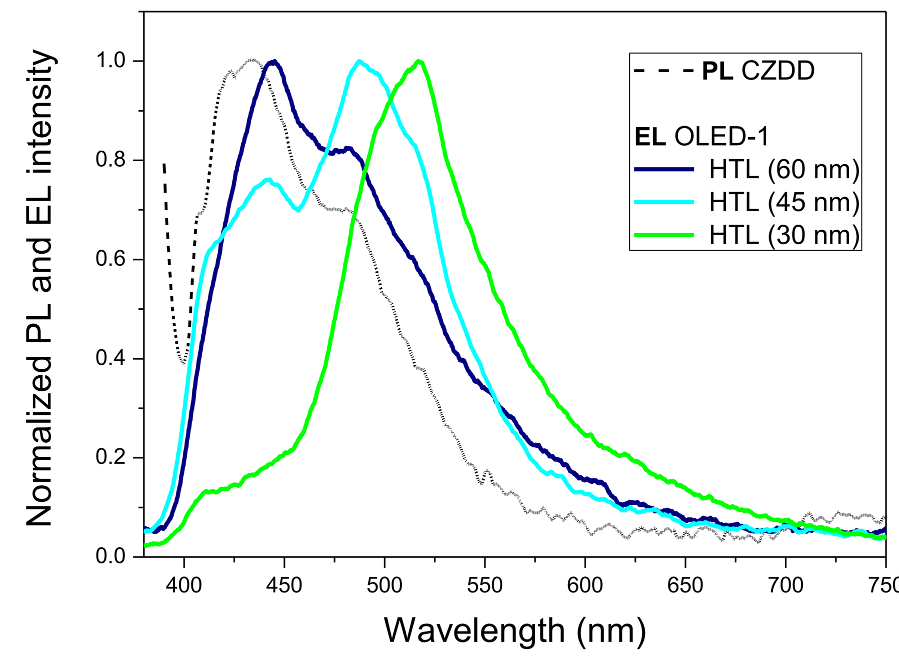

Fig.5. PL spectrum of the CZDD and EL spectra (bias 14 V) of the devices manufactured with the OLED-1 structure; the PEDOT:PSS thickness were 60 nm, 45 nm and 30 nm.

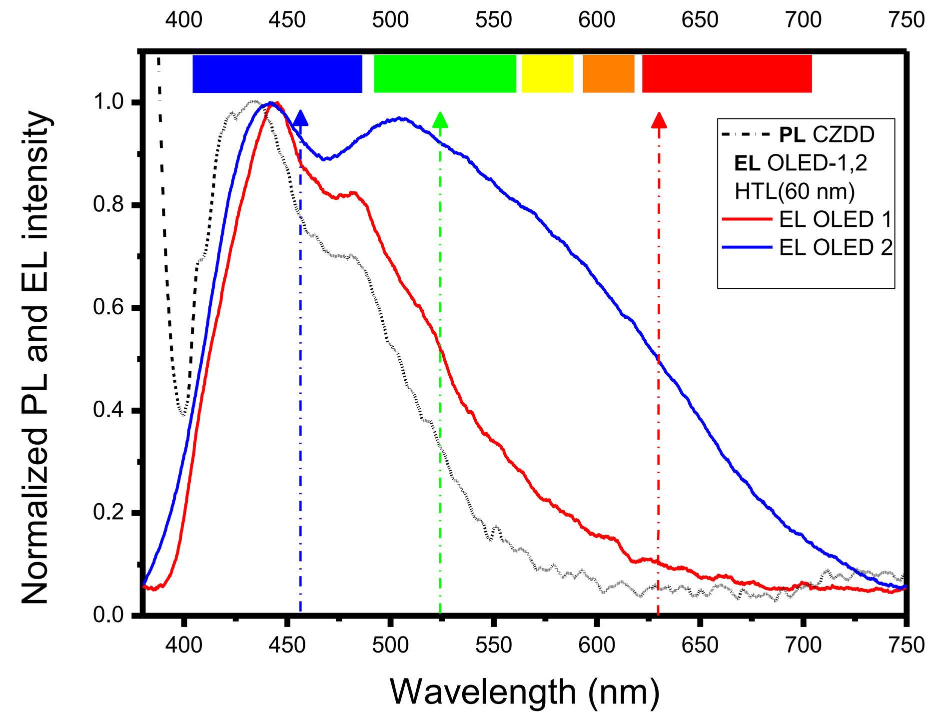

Fig 6. Normalized EL spectra for OLED-1 and OLED-2 (bias 12 V) with PL spectrum of the CZDD; both OLEDs have the same HTL thickness (60 nm).

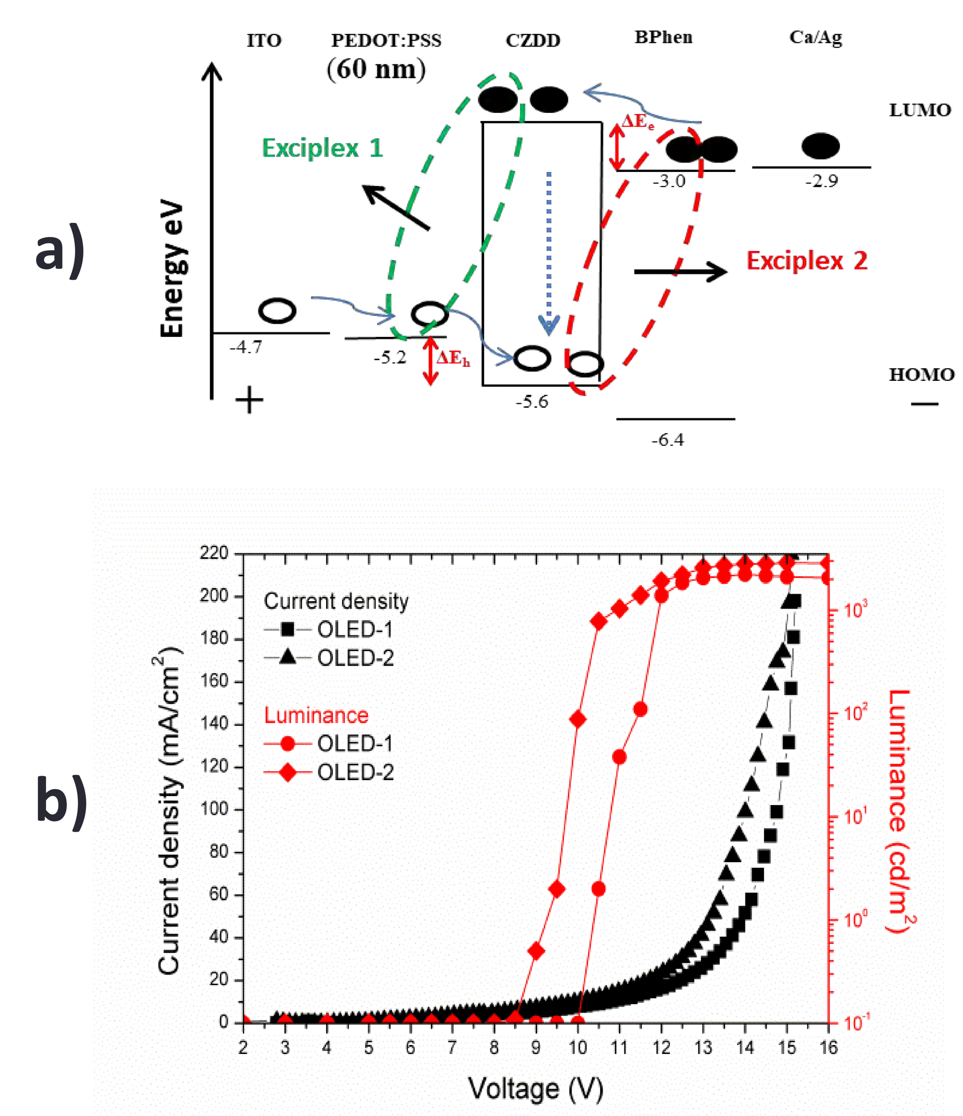

Fig.7. a) Scheme for the exciton and exciplex transitions in OLED devices. b) J-V-L curves for the OLED-1 and OLED-2

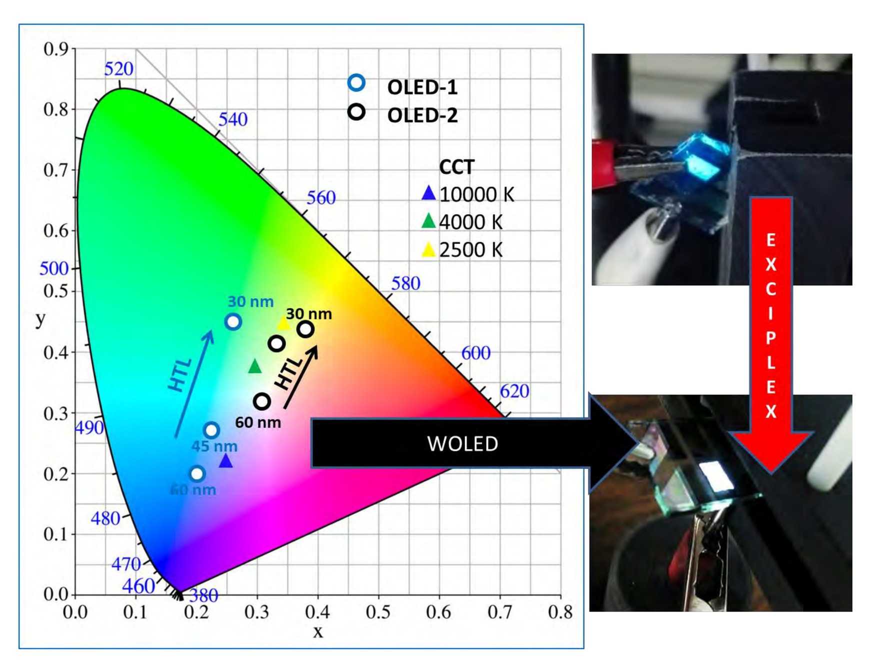

Fig.8. CIE coordinates of the OLEDs represented in the CIE map 1931

CONCLUSIONS

A single layer WOLED based on a new carbazole derivative with CIE coordinates (0.31, 0.33) is reported. The white light emission was obtained from a complementary emission of excitons and exciplexes. Exciplex states were observed at the two interfaces of the active layer with HTL and ETL. By changing the thickness of the HTL, tuning of emission of the devices was possible. From a first architecture without ETL, the pure blue emission from excitons could be tuned to greenish. With a second architecture, where the compound BPhen was used as ETL, the white emission was tuned from cold to warm. The maximum luminance value for the device with the best CIE coordinates (HTL:60 nm) was 2900 cd/m2 at 14 V, and the values of current efficiency and luminous efficacy were 3.1 cd/A and 6.1 lm/W respectively with a bias of 12 V; such values are very promising for these types of simplified devices.

References

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