NEW STRUCTURES TADF EMITTERS FOR THIRD GENERATION ORGANIC LIGHT EMITTING DIODES

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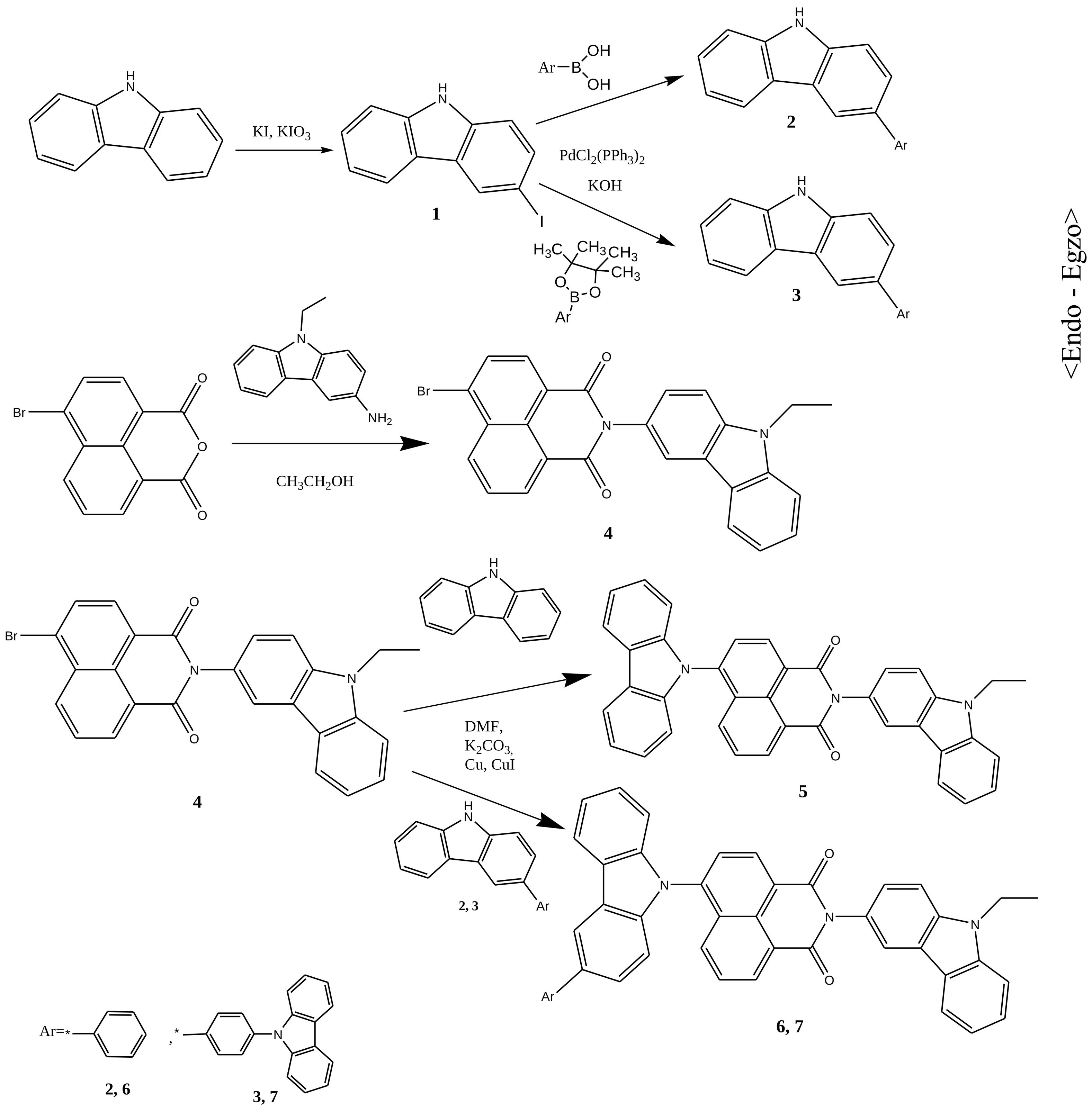
Introduction

Nowadays, there has been a lot of interest in third-generation organic light-emitting diodes characterized by thermally activated delayed fluorescence (TADF). This mechanism has been recently discovered and this is why the search for TADF materials and the formation of OLEDs using them are relevant in modern optoelectronics.
In this study, a new generation of electroactive compounds containing a 1,8-naphtalimide moiety were synthesized and characterized. These compounds were used in the emitting layers of organic light-emitting diodes as emitters.

Materials



Scheme 1. Schematic illustration of compounds **5-7**.

Thermal properties

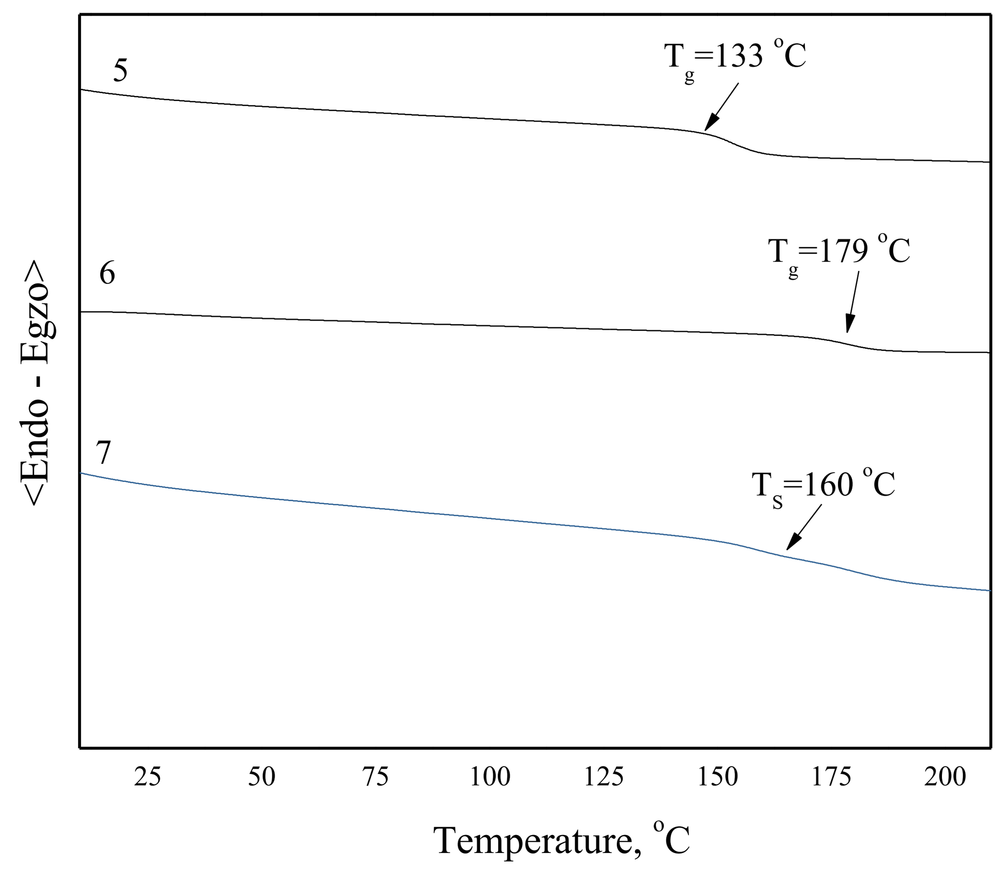


Figure 1. DSC curves of materials **5-7**.
Heating rate was 10 °C/min.

The behavior under heating of the prepared derivative **5-7** was studied by DSC and TGA under a nitrogen atmosphere. It was obtained during the TGA analysis that the materials has sufficient thermal stability, and its temperature of 5% mass loss are from 246 °C to 366 °C. DSC measurements have demonstrated that the glass transition temperatures ranged from 133 °C to 160 °C.

Compound	T_d, °C	T_g, °C	T_m, °C
5	246	133	
6	353	179	191
7	366	160	205

OLED characteristis of the devices with the configuration: ITO/PEDOT:PPS/CBP:5,6 or 7/TPBi/LiF/Al

Emitter	Dopant wt %	ON (V_{on})	$PE_{1000}/CE_{1000}/EQE_{1000}$ (lmW^{-1}, cdA^{-1}, %)	$PE_{max}/CE_{max}/EQE_{max}$ (lmW^{-1}, cdA^{-1}, %)	CIE_{xy} coordinates (@1000 cdm$^{2-1}$)	Max. Lum. (cdm$^{2-1}$)
5	5	4.0	0.3/0.7/0.3	3/2.9/1.14	(0.21;0.36)	1359
	7.5	3.9	0.3/0.7/0.3	10.9/12.2/1.03	(0.21;0.43)	2007
	10	4.0	0.3/0.6/0.22	2.9/2.8/1.14	(0.22;0.42)	1823
6	5	4.0	0.7/1.4/0.46	6.2/6.9/1.58	(0.24;0.45)	2364
	7.5	3.8	0.6/1.3/0.51	7.5/7.2/2.14	(0.26;0.49)	2655
	10	3.9	0.7/1.3/0.46	6.8/6.5/2.80	(0.28;0.51)	2879
7	5	4.1	0.6/1.3/0.47	7.7/7.9/3.3	(0.26;0.46)	2212
	7.5	3.8	0.6/1.2/0.45	9.0/10.0/2.39	(0.28;0.49)	2377
	10	3.7	0.5/1.2/0.44	9.3/8.8/2.9	(0.29;0.51)	2253

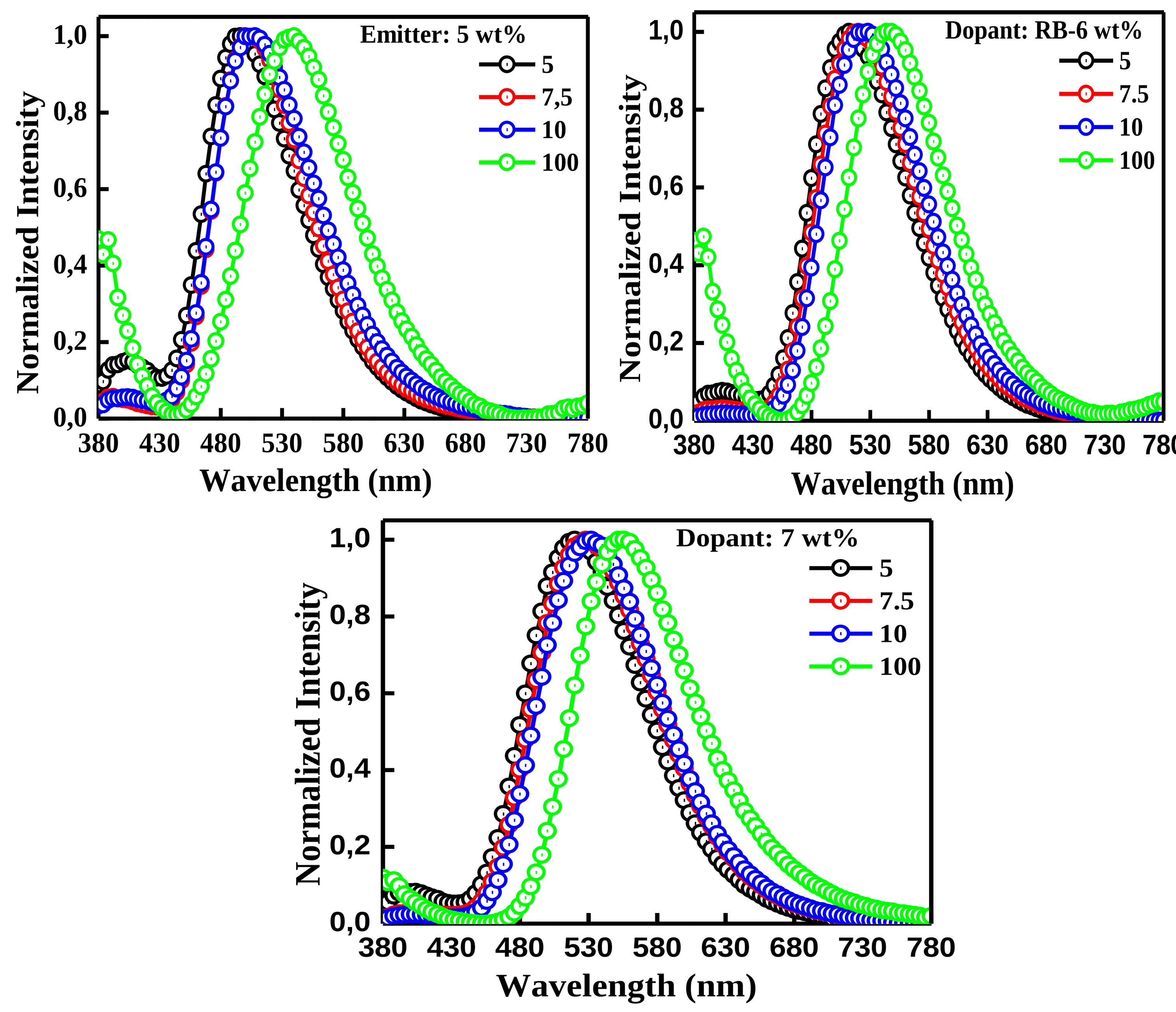


Figure 2. Electroluminescent characteristics of the devices

Conclusions

In conclusion, the materials demonstrated high thermal stability (246-366 °C) and their glass transition temperatures ranged from 133 to 160 °C. The compounds have been tested as emitters in organic light emitting diodes with a commercial host of di(N-carbazolyl)biphenyl (CBP). Between all the prepared devices, the best prototype was OLED using CBP host in the emissive layer and 7.5% of N-(9-ethylcarbazol-3-yl)-4-{3-[4-(carbazol-9-yl)phenyl]carbazol-9-yl}-1,8- naphthalimide as TADF emitter. The device has demonstrated a maximum luminance of 2377 cd/m^2, achieved 10 cd/A current efficiency, 9 lm/W power efficiency and 2.39 % maximum external quantum efficiency.

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