

# Copolymers with pendent phenoxazine/arylbenzimidazole moieties as bipolar polymeric hosts for green PhOLEDs

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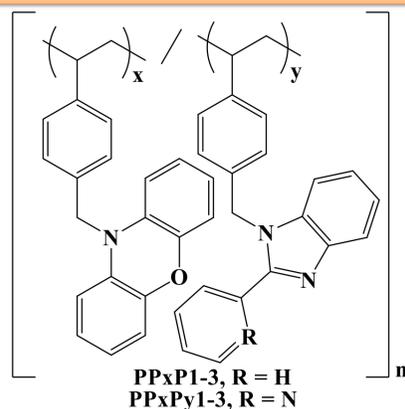
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## INTRODUCTION & AIM

Fluorescent derivatives were used as emitting materials of organic light emitting diodes (OLEDs) at the beginning in the research field, but the intrinsic low internal quantum efficiency of 25% of the fluorescent emitters limited the application of fluorescent devices. It is known that the ratio of singlet excitons to triplet excitons is 1:3 and the triplet excitons cannot be utilized for light emission in common organic emitting materials. In the phosphorescent devices, which can utilize up to 100% of excitons, to reduce quenching associated with relatively long excited-state lifetimes of triplet emitters and triplet-triplet annihilation etc., triplet emitters are normally used as emitting guests in a host material, and thus suitable hosts are widely investigated for the phosphorescent devices. In pursuit of this ever-growing need for new host materials, a group of vinyl copolymers containing electronically isolated phenoxazine and phenylbenzimidazole or pyridylbenzimidazole chromophores has been prepared by the multi-step synthetic route. Full characterization of their structures has been presented by NMR spectroscopy, elemental analysis and gel permeation chromatography. The polymeric materials represent derivatives of high thermal stability with initial thermal degradation temperatures with a very high glass transition temperatures of the amorphous polymers range from 151 °C to 160 °C and only slightly depend on structures of the aromatic chromophores. The synthesised materials were tested as hosts in phosphorescent OLEDs with bis(2-phenylpyridine)(acetylacetonato)iridium(III), [Ir(ppy)<sub>2</sub>(acac)], as the emitter.

## MOLECULAR STRUCTURES



## MOLECULAR WEIGHTS AND THERMAL PROPERTIES

Table 1. Monomeric composition of reaction mixtures, molecular weights and PDI and thermal properties of the polymeric products

Polymer	Phenoxazine-based monomer amount in reaction mixture, %	Phenylbenzimidazole-based monomer amount in reaction mixture, %	Pyridinylimidazole-based monomer amount in reaction mixture, %	M <sub>n</sub> , g/mol	M <sub>w</sub> , g/mol	PDI	T <sub>d</sub> , °C	T <sub>g</sub> , °C
PPx	100			1160	2340	2,01	307	152
PPxP1	80	20		1810	4130	2,28	300	155
PPxP2	50	50		2440	6600	2,70	320	160
PPxP3	30	70		2220	4140	1,86	310	153
PPxPy1	50		50	920	1670	1,82	305	154
PPxPy2	25		75	1820	3740	2,05	315	151
PPxPy3	75		25	1140	2710	2,38	305	157

Figure 1. Structure of newly synthesized polymeric materials

## OLED CHARACTERIZATION

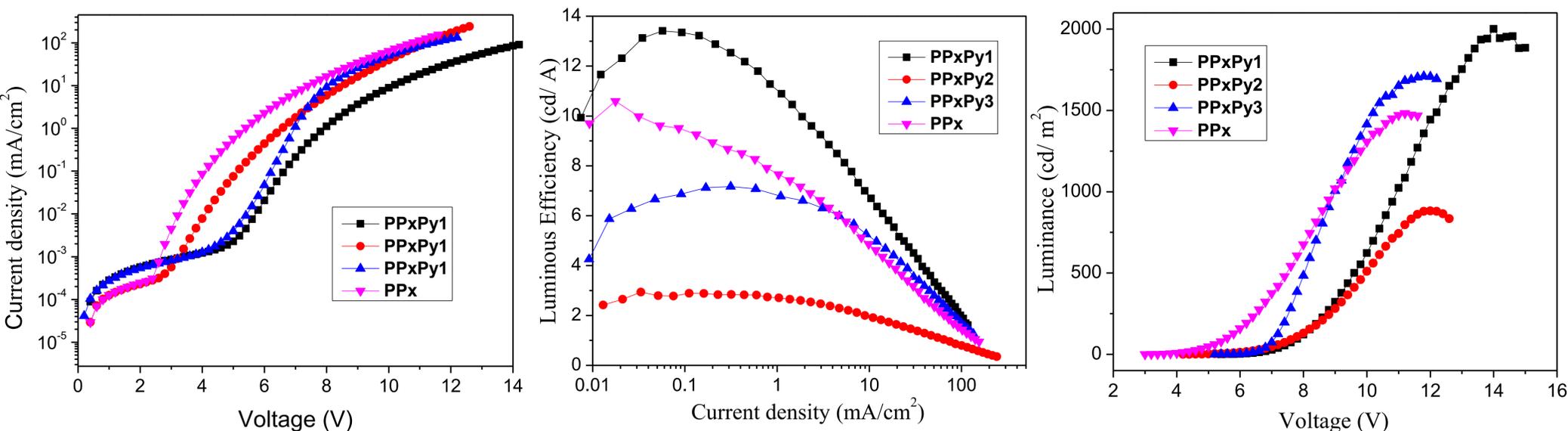


Figure 2. OLED characteristics of the devices containing hosts of copolymers PPxP and of PPx. In figures displayed voltage – current density (left), current density – luminous efficiency (center) and voltage – luminance (right) characteristics

## CONCLUSIONS

These findings in characteristics of the PhOLED devices look rather promising when compared to the similar devices containing poly(9-vinylcarbazole) as a host. It should be pointed out that these characteristics were obtained in non-optimized test devices under ordinary laboratory conditions. The device performance may be further improved by an optimization of the layer thicknesses and processing conditions. In conclusion, vinyl co-polymers containing electronically isolated phenoxazine (electron donor) and 2-phenylbenzimidazole (electron acceptor) or 2-(2-pyridyl)benzimidazole (electron acceptor) were synthesized from the corresponding vinyl monomers by cationic polymerization in solution. The amorphous polymers show high thermal stability having high thermal degradation temperatures of 300–320 °C as well as very high morphological stability of amorphous films with glass transition temperatures of 151–160 °C. The synthesised materials were tested as hosts in phosphorescent OLEDs with bis(2-phenylpyridine)(acetylacetonato)iridium(III), [Ir(ppy)<sub>2</sub>(acac)], as the guest. The best device using co-polymer PPxPy1 with phenoxazine as electron donor and 2-(2-pyridyl)benzimidazole as electron acceptor exhibited the promising performance with low turn-on voltage of 3.0 V, maximum brightness exceeding 2000 cd/m<sup>2</sup> and maximal photometric efficiency of about 13.4 cd/A. The similar device using co-polymer PPxP3 with chromophores of phenoxazine (electron donor) and 2-phenylbenzimidazole (electron acceptor) as the bipolar host exhibited the best overall performance with low turn-on voltage of 3.0 V, maximum brightness exceeding 2800 cd/m<sup>2</sup> and maximal photometric efficiency of about 13.0 cd/A.

### Acknowledgements

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