NAPHTYL SUBSTITUTED TRIPHENYLAMINE DERIVATIVES AS HOLE TRANSPORTING MATERIALS FOR EFFICIENT RED PHOLED

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Phosphorescent organic light emitting diodes (PhOLEDs) have drawn much attention because they use both singlet and triplet excitons for the emission of light and 100% internal quantum efficiency is possible in this case. The high internal quantum efficiency depends on several factors such as high quantum yield emitters, exothermic energy transfer from host to emitter, effective exciton confinement as well as balanced carrier transport [1, 2]. It is well demonstrated that carrier transporting materials are very important to enable a balanced carrier transport from cathode and anode [3, 4].

The synthesis of naphthyl substituted triphenylamine compounds (**1NTPA**-**3NTPA**) was carried out by two step synthetic route as shown in Scheme 1. Tris(4-bromophenyl)amine (**2**) as a key material was obtained by bromination reaction of triphenylamine (**1**) with *N*-bromosuccinimide in DMF. 1-Naphthyl substituted derivatives **1NTPA**-**3NTPA** were obtained by the Suzuki reaction of the tris(4-bromophenyl)amine (**2**) with 1-naphthalene boronic acid.

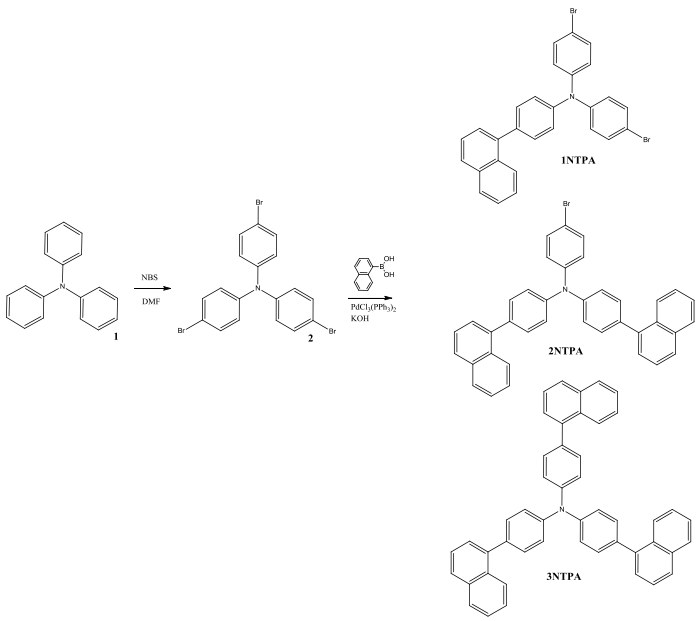

Fig. 1. Synthetic route to 1NTPA-3NTPA .

Naphthyl substituted triphenylamine and its derivatives with bromine atoms were synthesized and investigated. The respective glass transition temperatures of the materials were estimated to be in a range 65-137 ℃, which can provide morphologically-stable amorphous films for applications in organic light emitting diodes. The compounds possess adequate ionization potentials (5.5-5.75 eV), high hole drift mobilities (>10^{-3} cm^2/ V·s) and suitable triplet energies (~ 2.4 eV), which make them suitable hole transporting materials for use in red phosphorescent organic light-emitting diodes. A superior peak efficiency of 17.9% (31.4 cd/A and 26.9 lm/W) was achieved in a device having hole transporting layer of tris[4-(1-naphthyl)phenyl]amine. Furthermore, the device gave efficiencies of 17.7% and 16.6% recorded at luminance levels of 10^2 and 10^3 cd/m^2. The efficiency drop from the maximum to the value recorded at the luminance of 10^3 cd/m^2 for the device was only 7%.

Acknowledgements. This research was funded by a grant No. S-MIP-17-64 from the Research Council of Lithuania.

[1] C.-H. Chang, C.-L. Ho, Y.-S. Chang et al., Blue-emitting Ir(III) phosphors with 2-pyridyl triazolate chromophores and fabrication of sky blue- and whiteemitting OLEDs, J. Mater. Chem. C, **1** 2639-2647 (2013).

[2] J. Huang, B. Xu, J.H. Su, et al., Efficient blue lighting materials based on truxene-cored anthracene derivatives for electroluminescent devices, Tetrahedron **66** 7577-7585 (2010).

[3] J. Huang, J.H. Su and H. Tian, The development of anthracene derivatives for organic light-emitting diodes, J. Mater. Chem. **22** 10977-10989 (2012).

[4] C. W. Lee, J. Y. Lee, A hole transport material with ortho- linked terphenyl core structure for high power efficiency in blue phosphorescent organic light-emitting diodes, Org. Electron. **15** 399-404 (2014).