Photo- and Electroluminescence of New Organic Semiconducters

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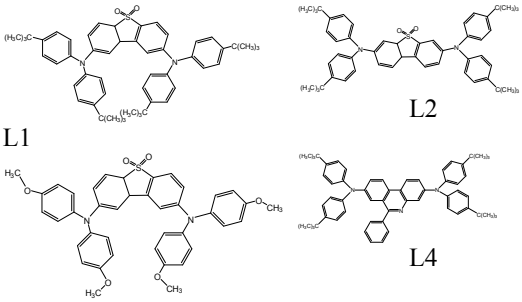
New organic compounds possessing semiconducting properties have been synthesized and investigated. The molecular structures are shown in Fig. 1

The photophysical properties of molecules have been studied in chloroform solutions and in films obtained by thermovacuum deposition (TVD).



L1 L2 L3 L4

Fig.1 The molecular structures of compounds

Electroluminescence has been investigated in OLED structures ITO/PEDOT/NPD/L1-L4/Ca/Al.

The emission spectral region of compounds under photo- and electroexcitation practically coincides (Table). Despite the fact the structures of the molecules are similar, their electroluminescent properties are markedly different (Fig.2).

Table.

Compound	λ_{PL}, nm	λ_{EL}, nm	Brightness, Cd/m^2 (8V)	Efficiency, Cd/A
L1	505	509	1200	0,40
L2	485	480	400	0,11
L3	538	535	2300	1,28
L4	500	530	60	0,09

In this work we have considered the role of the mechanism thermally activated delayed fluorescence in forming of the electroluminescence of the OLED structures. According to quantum statistic [1-2] the ratio of singlet and triplet excitons at electroexcitation is 1:3. Radiation occurs in most cases from the singlet S_1 state. The efficiency of the OLED can be higher if a thermally activated triplet singlet conversion is possible.

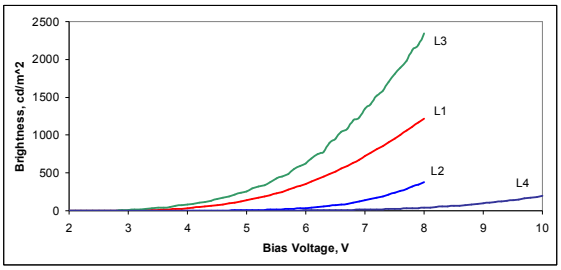


Fig.2 Volt-brightness characteristics of the structure ITO/PEDOT/NPD/L1-L4/Ca/Al.

The smaller the ST gap, the higher the probability of a triplet-singlet conversion.

To estimate the position of the triplet level, phosphorescence was studied at a temperature of 77 K. The $\Delta(S_1\text{-}T_1)$ gap was found to be 1100 cm^{-1} (0.141 eV) for L3 and 2020 cm^{-1} (0,256 eV) for L4.

In the Fig.3 the fluorescence and phosphorescence spectra of the L3 and L4 at 77K are shown.

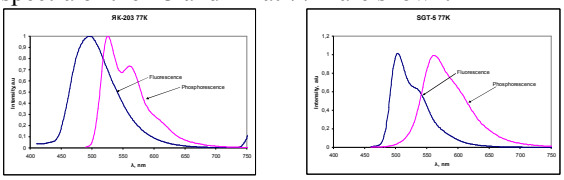


Fig.3. The fluorescence and phosphorescence spectra of L3 and L4 at 77K.

Thus, it can be seen that the ST gap for L3 is almost two times narrower than for L4. Perhaps this fact is the cause of a strong difference in the electroluminescence intensity of compounds L3 and L4.

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[1] M. A. Baldo Physical Review B, V.60, No.20, p.14422

[2] Z. Shuai and et al, Phys. Rev. Lett., 2000. V.84, No.1, P.131.