Indolo ir benzo[b]karbazolo dariniai – mėlyni spinduoliai nelegiruotiems organiniams šviesos diodams

Indole and benzo[b]carbazole derivatives as blue emitters for non-doped light emitting diodes

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Organic light emitting diodes have attracted considerable attention due to their great application potential in large area flat panel displays and solid state lighting [1]. The search for suitable materials for these devices is still a subject of interest. Unbalanced charge injection and transport is a major problem in blue or deep-blue OLEDs, especially in non-doped devices [2, 3]. Balancing the charge transport is one of the most important factors to obtain highly efficient OLEDs. Recently, bipolar materials containing electron donor and electron acceptor moieties were used to improve the balance of charge transport in OLEDs [4].

The selection of appropriate materials for each layer of OLED is of great importance. However, most of the methods used for the synthesis of electroactive materials suffer from the drawbacks such as low yields, prolonged reaction times, use of hazardous, expensive, moisture-sensitive reagents, harsh reaction conditions, tedious workup procedure, and difficulty in recovery, and reusability of the catalysts [5]. Therefore, there is a need to develop efficient and versatile methods for the synthesis of electroactive compounds with the balanced mobility values of holes and electrons.

In this work, regioselective acid-catalyzed reactions of 1*H*, 1-methyl, and 1-naphthylindole with *o*-phthalbenzaldehyde were employed for the synthesis of efficient charge-transporting and emitting materials.

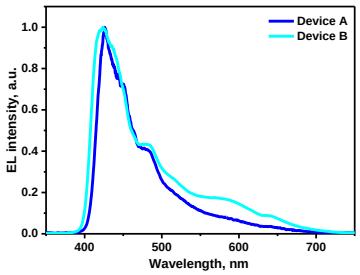

Figure 1. Electroluminescence spectra of two non-doped OLEDs

The synthesized materials were characterized by NMR, IR and mass spectrometries. They form molecular glasses with glass transition temperatures ranging from 86 to 116 °C. Naphthyl- substituted derivatives of indolyl benzo[b]carbazole show high thermal stabilities with 5 % weight loss temperatures of 409 and 413 °C, while their methyl-substituted counterparts exhibit by ca. 90 °C lower 5 % weight loss temperatures. Their solutions exhibited blue emission with quantum yields up to 67 %. The newly synthesized derivatives are electrochemically stable. Their ionization potential values estimated by cyclic voltammetry are in the range of 5.49–5.65 eV, while the values obtained using photoelectron emission spectrometry are in the range of 5.16–5.28 eV. The layers of the compounds exhibit ambipolar charge transport with time-of-flight charge drift mobility values well exceeding 10^{-3} $cm^2/(Vs)$ at high electric fields. The non-doped naphthylindole and benzo[b]carbazole-based device B emitted deep-blue light (Figure 1) with the emission maximum at 410 nm and CIE of (0.21, 0.16), and it exhibited a maximum EQE of 4.7 %.

Keywords: OLED, indole, benzocarbazole,bipolar charge transport.

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