NEW ELECTROACTIVE POLYMERS WITH ELECTRONICALLY ISOLATED 4,7-DIARYLFLUORENE MATERIALS FOR OLEDS

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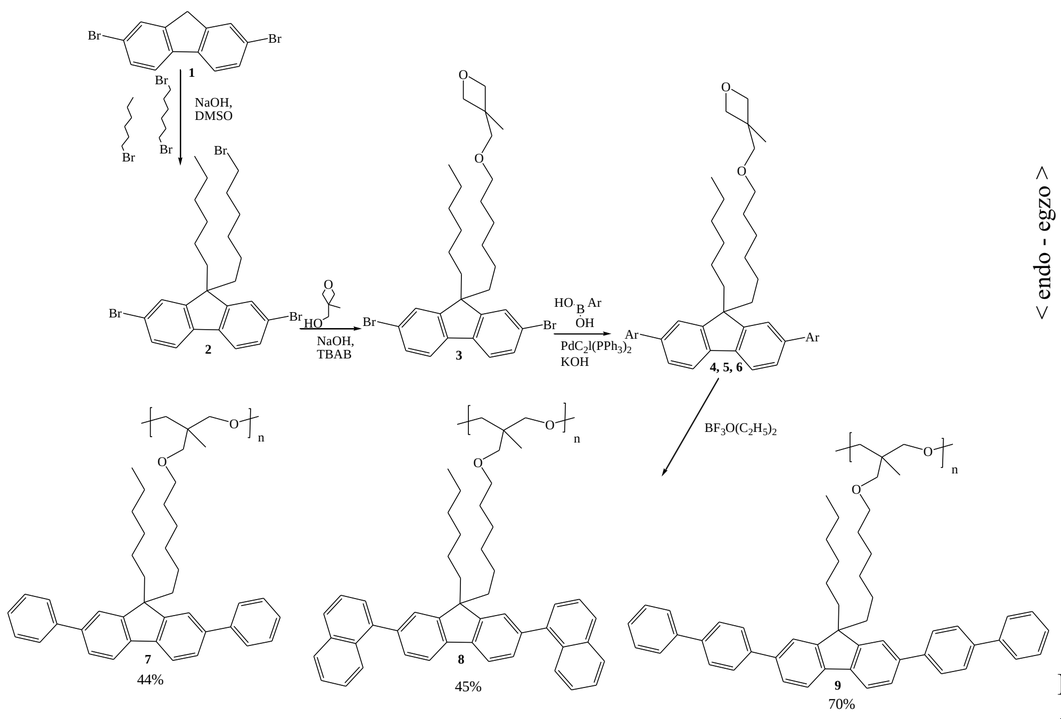
Introduction

The advantages that organic light emitting diode (OLED) based technologies offer in terms of brightness, viewing angle, contrast ratio, production cost, opportunity for flexible displays, etc. are not rivaled by liquid crystal-based displays. It is well established that multilayer devices comprising hole transport layer (HTL), electron transport layer and emissive layer are necessary for efficient light emission .

One method that is very widely used to increase efficiencies of the organic light emitting devices is the incorporation of effective hole transporting layers in the structures of the OLEDs. The charge transporting layers can be fabricated from low molecular weight compounds by vapor deposition or from polymeric materials by spin coating from prepared solutions. The solution based rout has the advantages, e. g. the production costs are lowered, large areas can be formed and the molar mass of the materials is not limited .

Synthesis



Scheme 1. Schematic illustration of the synthesis of the polymers **7-9**.

Polymer	M_n	M_w	PDI
7	2730	3690	1,35
8	3930	8210	2,09
9	6720	17640	2,63

Molecular weights and PDI of the oligomers **7-9.**

Characteristics of polymers 7-9

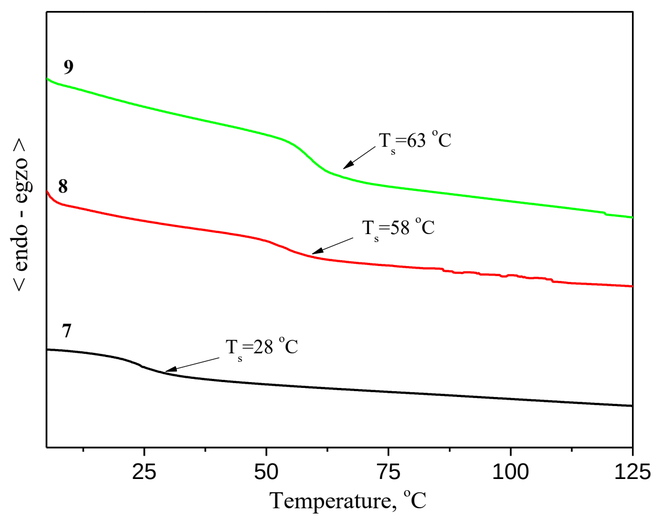


Figure 1. DSC curves of polymers **7** - **9**. Heating rate was 10 °C/min.

DSC measurements have demonstrated that the synthesized polymers **7 -9** are amorphous materials with clearly expressed glass-transition temperatures (T_g). The curves of second heating of DSC measurements, which show the most exact T_g values of the polymers, are presented in Figure 1. It could be seen that the glass-transitions of the polymeric materials were observed at temperature of 28 ºC for **7,** at 58 ºC for **8**, and at 63 ºC for **9**, and no peaks due to melting or crystallisation were obtained during all the measurements, i.e. the polymers are amorphous and suitable for preparation of thin homogeneous layers.

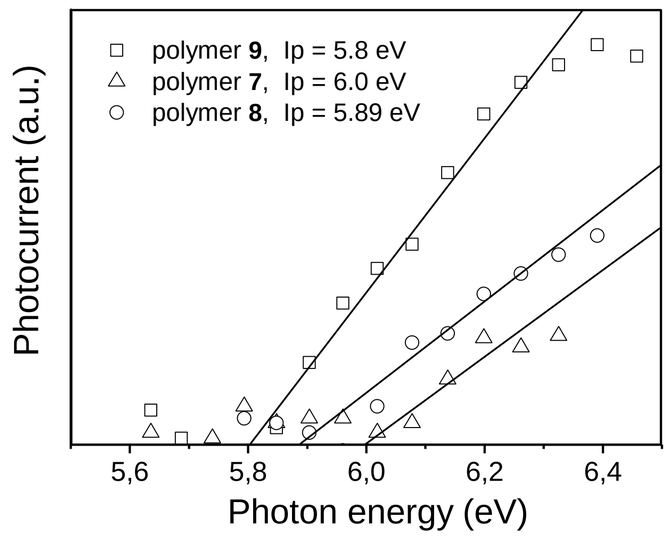


Figure 2. Electron photoemission spectra of thin layers prepared using the polymers **7-9.**

Thin amorphous layers of the polymers **7 - 9** were used for measurements of ionization potentials (I_p) of these materials having various chromophores. The values of I_p were establisheded from electron photoemission spectra of the thin films. The spectra and values of the I_p are shown in Figure 2. It could be observed that I_p of the materials range from 5.8 to 6.0 eV and depend on chemical compositions of the chromophores. Layer of polymer **8** having biphenyl substituted fluorine fragments demonstrated the lowest I_p of 5.8 eV due to longer conjugated system in the aromatic fragments. I_p of the polymer **7** with bi-phenyl substituted fluorine chromophores had the highest value, which reached 6.0 eV.

OLED characterisation

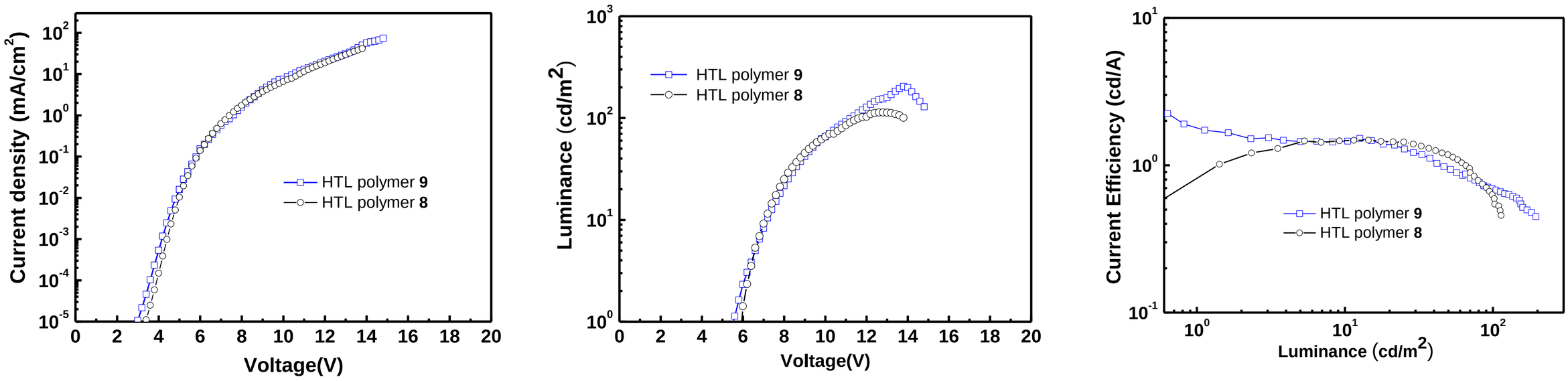


Figure 3. OLED characteristics of the devices with the configuration: ITO/**8** or **9**/Alq_3/LiF/Al.

Conclusions

In conclusion, new electro-active polymers having 4,7-diarylfluorene chromophores were prepared by cationic polymerization of the corresponding oxetane-based monomers. The amorphous materials demonstrated very high thermal stability (392- 397 °C) and glass transition temperatures in a range of 28-63 °C). Electron photoemission spectra of thin films of the polymers confirmed that ionization potentials of the materials are depending on their chromophores and are in a range from 5.8 eV to 6.0 eV. The potentials could be suitable for hole injection and transport into emitting layers having high ionization potentials. The polymers have been tested as positive charges transporting films in bilayer organic light emitting diodes with tris(quinolin-8-olato)aluminium (Alq_3) as an emitter as well as electron transporting layer. An OLED device with polymer having electro-active 2,7-di(4-biphenyl)fluorine chromophores exhibited the best overall performance with low turn on voltage of 3 V, maximum brightness exceeding 200 cd/m^2 and current efficiency of 1.7 cd/A. These OLED properties are rather promising among Alq_3-based two-layer devices having polymeric hole transporting layers. The efficiency of the most effective prepared |OLED was about twice higher than those of the devices containing commercial hole transporting material of poly(9-vinylcarbazole) (PVK).

Acknowledgments. OLED materials were developed in the frame of project funded by the Research Council of Lithuania (grant No. S-LLT-19-2).