



Opponent's assessment of the dissertation

Title: Preparation and characterization of nanocomposite thin films for polymer electronics

Author: Bitá Ghasemi

Opponent: RNDr. Eva Majkova, DrSc., Institute of Physics SAS, Bratislava

The submitted dissertation consists of 8 chapters. The aim and objectives of dissertation are formulated on p. 24. The basic aims of the work are defined as i) studies of the correlation between the structure of conductive polymers in thin films and their optoelectronic and electrical characteristics and ii) introduction of non conductive nanofiller to a polymer matrix in order to achieve specified optical and electrical properties. Based on these aims the following objectives were formulated: polymer thin film preparation and characterization, nanocomposite preparation and study of nanofillers on the performance of the prepared LED devices

The performed studies demonstrated non-trivial thickness dependence of optoelectronic properties and structural order in thin conductive poly(9,9-dioctylfluorene-altbenzothiadiazole) F8BT polymer films.

For the nanopolymer nanocomposite poly[2-methoxy-5-(2-ethoxyloxy)-1,4-phenylenevinylene] MEH-PPV and Al₂O₃ nanowires, a strong effect on the ordering and electronic structure was observed. The PLED devices based on the nanocomposite were prepared and characterized in terms of their performance.

The topic of the dissertation is up-to-date and attractive. Semiconductor conjugated polymer films are at present promising candidates to be utilized in a broad range of organic electronic devices due to their easy structure modification and solution processability.

I can state that the main goals of the work were fully met. The PhD student demonstrated the ability to solve independently scientific research problems. The methodology of the work is designed correctly. The selected experimental methods are complementary and allowed convincing interpretation of the observed phenomena. On the other hand, they document the experimental skills of the PhD student.

From a formal point of view, the thesis meets the required standards. The structure of thesis follows recommendations for PhD thesis. All literature sources are correctly cited according to the citation standard. The publication output of the PhD study is adequate.



Comments /Questions on author

P. 20 instead of "grain border", "grain boundary" should be used

When a thin polymer layer is deposited by the drop casting of the solution, the drying process is fast and the polymer crystalline phase cannot be well developed. With a thicker layer, a thin dried layer (skin) first forms on the top of the film and the evaporation of the solvent slows down, leading to the formation of a well-developed crystalline phase. This process is common to several types of solutions. Could you discuss this effect with respect to your results? Did you try to affect the drying process e.g. by solvent annealing procedure, which could improve the crystallinity of the deposited layer?

What are the most important reasons for using Al_2O_3 nanowires as nanofiller for MEH-PPV – Al_2O_3 nanocomposite?

P.54: in the GIWAXS description, the unit of the angle of incidence is missing.

In Fig. 34, the GIWAXS patterns of neat MEH-PPV and nanocomposite MEH-PPV – Al_2O_3 are presented. It is rather surprising that the presence of 20 vol% of Al_2O_3 is not observed in the GIWAXS pattern. According to several published data, the Al_2O_3 nanoparticles are generally crystalline. The crystalline structure should be even more probable for the wires several hundreds nm long. Could you explain this fact?

For the preparation of functional device, the nanocomposite layer was annealed (dried) at 150 C, the time is not given. Were all the layers of MEH_PPV annealed (dried) at 150 C? What was the effect of such a treatment on the nanocomposite layer ?

In summary, I recommend the submitted PhD dissertation for defense and after a successful defense to award the PhD student the degree Doctor of Philosophy.

Bratislava, 23rd March, 2024

RNDr. Eva Majkova, DSc.