Łukasz Janasz
Number of album 800641

Abstract of the thesis "Influence of morphology on charge carrier transport in ultrathin films of Poly(3-hexylthiophene-2,5-diyl)"

Supervisors:

Prof. dr hab Jacek Ulański,

Prof. dr hab. Wojciech Pisula

Assigned reviewers:

- **prof. dr hab. Jeremiasz Jeszka**
  Politechnika Łódzka, Wydział Technologii Materiałowych i Wzornictwa Tekstyliów, Katedra Włókien Sztucznych
- **dr Eric Glowacki**
  Linköping University, Department of Science and Technology, Division of Physics and Electronics

Examiners:

- **prof. dr hab. Jeremiasz Jeszka**
  Politechnika Łódzka, Wydział Technologii Materiałowych i Wzornictwa Tekstyliów, Katedra Włókien Sztucznych
- **dr hab. Ireneusz Glowacki**
  Politechnika Łódzka, Wydział Chemiczny, Katedra Fizyki Molekularnej

The thesis presents research in an area of organic electronics, and the results are discussed in a broader context of charge transport phenomenon and technological applications. The basic components of any electronic circuit - organic field-effect transistors (OFETs) were fabricated on the basis of ultrathin (thickness $\leq$ 10 nm) layers of popular *p*-type conjugated polymer – Poly(3-hexylthiophene-2,5-diyl (P3HT). The experimentally established values of charge carrier mobility were correlated with the morphology of P3HT films with different thicknesses. Layers thicker than approx. 8.0 nm showed significantly higher mobility than their thinner counterparts. This phenomenon was explained by changes in the charge transport mechanisms (change from two- to three-dimensional percolation network transporting charge carriers) as well as by morphology variations. To improve the charge carrier mobility of ultrathin P3HT films, the morphology was tailored by inducing aggregation of the polymer chains in solution. Such approach resulted in layers consisting a net of P3HT fibrils, which significantly enhanced the charge carrier mobility. To increase functionality of the OFETs based on ultrathin P3HT films, another, *n*-type semiconducting molecule, phenyl-C61-butyric acid methyl ester (PCBM) was added to the solution with aggregated polymer to achieve ambipolarity. The obtained films consisted of hole transporting P3HT fibers embedded in a continuous, electron transporting PCBM matrix. The best OFETs based on such nanocomposites showed balanced ambipolar transport of holes and electrons with mobilities exceeding the values reported in literature for ambipolar OFETs.

23.03.2018

Ł Janasz