

Investigation of the thermal transitions and electrical properties of thin films of semiconducting polymers

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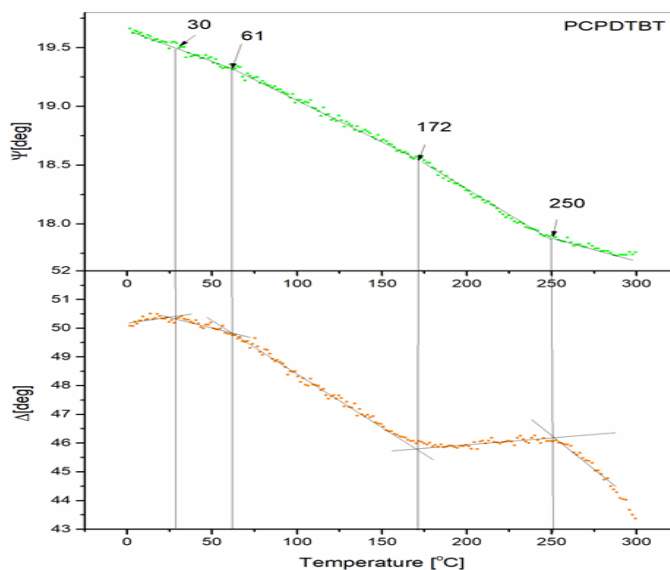
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Abstract

Statement of the Problem: Organic semiconductors are widely used in organic electronics, including organic light-emitting diodes (OLED), field-effect transistors (OFETs), or photovoltaic devices (PVDs) such as organic solar cells (OSCs) and photosensors, where they act as active layer components. Particularly promising is the use of organic materials in functional electronic systems with high flexibility and low weight, such as biosensors using the structure of an organic field-effect transistor (OFET). The thermal stability of the structure organic and hybrid materials for electronics applications determines the service life of specific devices. This aspect becomes particularly important in applications operating at variable and elevated temperatures. Thus, the extremely important improvement of thermal stability with maintaining high operating parameters of these devices, and especially energy efficiency.

Conclusion & Significance: The aim of the presented paper was to research the identification of thermal transitions of modern semiconducting polymeric materials for applications in optoelectronic and photovoltaic systems. The article also presents the influence of temperature on the electrical resistance of the polymer thin films. The following materials were selected for testing: PCPDTBT and PDPP4T. From the application point of view, especially in photovoltaic applications exposed to variable temperatures, it is important to determine the influence of temperature on the basic parameters of the thin films of this materials. The results analysis of conducted research suggests that the phase composition of the blend affects the temperatures of phase transitions and the resistances of thin layers of semiconducting polymers.

Image



Dependence of ellipsometric angles Ψ and Δ on temperature for pure PCPDTBT thin films

Recent Publications

- Hajduk B., Jarka P., Bednarski H., Janeczek H., Kumari P., Farcas A., (2024) Thermal Transitions and Structural Characteristics of Poly(3,4-ethylenedioxythiophene/cucurbit[7]uril) Polypseudorotaxane and Polyrotaxane Thin Films. *Materials*, 17(6), 1318
- Li J., Ji S., Wei H., Gong J., Mao W., Zhang W., Shi L., Li X., Chu L., (2024), Multifunctional one-dimensional seeding layers enable stable and over 20%-efficiency inverted perovskite photovoltaic modules, *Nano Energy*, 122, 109329.
- Li C., Zhang A., Feng G., Yang F., Jiang X., Yu Y., Xia D., Li W., (2016), A systematical investigation of non-fullerene solar cells based on diketopyrrolopyrrole polymers as electron donor, *Organic Electronics*, 35, 112-117.
- Choudhurya B.D., Ibarra B., Cesanob F., Maoc Y., Hudad M. N., Chowdhurya A.R., Olivaresa C., Uddina M.J., (2020), The photon absorber and interconnecting layers in multijunction organic solar cell, *Solar Energy* 201/1, 28-44.
- Hajduk, B., Jarka, P., Bednarski, H. et al. Thermal and optical properties of P3HT:PC70BM:ZnO nanoparticles composite films. *Sci Rep* 14, 66 (2024). <https://doi.org/10.1038/s41598-023-47134-4>

Photograph



Biography

Prof. Tomasz Tański is the head of the Department of Engineering Materials and Biomaterials, Silesian University of Technology, Poland, and a member of the Committee of Metallurgy of the Polish Academy of Sciences. He is also a specialist in non-ferrous alloys, composite and nanostructured materials, and structural engineering materials. He has authored or co-authored more than 400 scientific publications worldwide, including 15 monographs and books. He has won twenty national and international awards and honors. He is and/or was a supervisor or contractor for more than fifteen research and didactic projects in Poland and abroad. He is also a reviewer and promoter of numerous scientific papers, including eight doctoral research papers in the field of nanotechnology and materials.