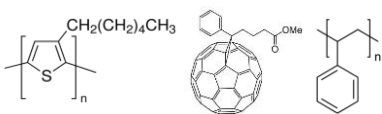

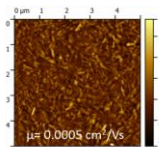
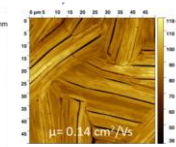
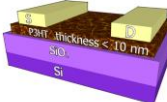





POLISH NATIONAL AGENCY
FOR ACADEMIC EXCHANGE



STER
PROGRAMME

<p>name of the unit:</p> <h2 style="text-align: center;">DIVISION OF ORGANIC ELECTRONICS</h2> <p style="text-align: center;">Department of Molecular Physics, Lodz University of Technology</p>		<p>symbol:</p> <p style="text-align: center;">K-31</p> <p style="text-align: center;">http://www.kfm.p.lodz.pl</p>
<p>Head of unit:</p> <p style="text-align: center;">Beata Łuszczynska, PhD, DSc, TUL Prof.</p>	<p>potential promoters:</p> <p>Beata Łuszczynska PhD, DSc, TUL Prof. Prof. Jacek Ulański, Prof. Wojciech Pisula, Jarosław Jung, PhD, DSc, TUL Prof., Gabriela Wiosna-Salyga, PhD Tomasz Marszałek, PhD Ewelina Witkowska, PhD Adam Łuczak, PhD</p>	<p>Contact person:</p> <p style="text-align: center;">Gabriela Wiosna-Salyga, PhD tel: 42-631-3225 gababriela.wiosna-salyga@p.lodz.pl</p>
<p>scope of activities:</p> <p>The team conducts research in one of the fastest growing areas of science and technology - organic electronics, using materials such as:</p> <ul style="list-style-type: none"> • molecules and polymers with conjugated bonding systems, • quantum dots, • graphene, • fullerenes and non-fullerene electron acceptors, • conductive and photoconductive composites and nanocomposites. <p>Organic light-emitting diodes (OLEDs), organic photovoltaic cells (OPVs), organic photodiodes (OPDs) and organic field-effect transistors (OFETs) are fabricated based on these materials. Thin or ultra-thin layers of organic compounds produced by vacuum and solution techniques are used to build electronic components. Inkjet printing techniques are also used, which opens up the possibility of making large-area and flexible devices using low-cost and energy-efficient methods. Materials, fabricated layers and devices are examined using advanced methods such as:</p> <ul style="list-style-type: none"> – AFM, STM and Raman microscopy – spectroscopies: UV-VIS-NIR, photoluminescence, thermoluminescence, electroluminescence, photovoltaic effect, impedance spectroscopy – tensiometry for determination of surface energy and surface wettability of thin films, – conductivity and photoconductivity measurements of organic semiconductors, – calcium test for determination of barrier properties of films for protection of devices against atmospheric factors. <p>Electro-optical parameters of manufactured devices are determined in accordance with applicable norms and standards.</p> <p>On the basis of test results analysis and modelling of observed physical phenomena responsible for the operation of devices is carried out.</p>		<div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>$\mu = 0.0005 \text{ cm}^2/\text{Vs}$</p> </div> <div style="text-align: center;">  <p>$\mu = 0.14 \text{ cm}^2/\text{Vs}$</p> </div> </div> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div>



POLISH NATIONAL AGENCY
FOR ACADEMIC EXCHANGE



STER
PROGRAMME

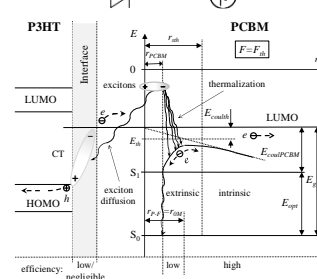
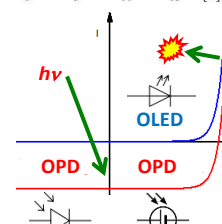
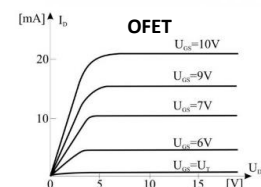
present activities:

Design, manufacture and performance testing of

- organic photovoltaic cells by solution methods, including application of the jet printing technique,
- organic light-emitting diodes as energy-efficient luminescent elements by printing methods (decorative and signalling elements),
- efficient emission layers for OLEDs (TADF, quantum dots, exciplexes, host-guest systems),
- organic OLEDs with electrodes made of graphene covered with a thin layer of rare earth oxides,
- organic OLED-OPDs for galvanic separation of electrical circuits,
- thin molecularly ordered layers of conjugated semiconductors and flexible OFET transistors.

The research is conducted within research projects in cooperation with leading Polish and foreign scientific centres) and innovative industrial companies. Students who carry out their engineering, master's and doctoral theses can serve internships in excellent research centres such as Max-Planck Institute for Polymer Research in Mainz, Leibniz Institute for Polymer Research in Dresden, or Institute of Macromolecular Chemistry of the Czech Academy of Sciences in Prague.

The Department of Molecular Physics is also a founding member of the consortium European Centre for Nanostructured Polymers (ECNP) and the National Photovoltaics Laboratory included in the National Map of Research Infrastructure,



future activities:

- Development of an original technology for printing light-emitting diodes with light-emitting layers containing quantum dots,
- Modification of electrode surfaces and investigation of electrode-semiconductor interfaces in printed organic optoelectronic devices,
- Fabrication by ink-jet of very high resolution metamaterials sensitive to radiation in the terahertz band gap and study of their properties,
- Manufacturing and testing of high-efficiency third-generation organic solar cells and modelling their operation using simulation methods,
- Fabrication of ultra-thin and flexible OFETs for applications including wearable electronics and sensors



POLISH NATIONAL AGENCY
FOR ACADEMIC EXCHANGE



publications/patents, awards, projects:

- Publications:
 - Yuan J., Zhang Y., Zhou L., Zhang G., Yip H.-L., Lau T.-K., Lu X., Zhu C., Peng H., Johnson P.A., Leclerc M., Cao Y., Ulanski J., Li Y., Zou Y., *Single-Junction Organic Solar Cell with over 15% Efficiency Using Fused-Ring Acceptor with Electron-Deficient Core*, *Joule* 3, 4, 17 April 2019, 1140-1151.
 - C.A., Szymanski M. Z., Luszczynska B., Ulanski J., *"Inkjet Printing of Super Yellow: Ink Formulation, Film Optimization, OLEDs Fabrication, and Transient Electroluminescence"*, *Scientific Reports*, 9, 2019, 8493.
 - Li M., An C., Marszalek T., Baumgarten M., Müllen K. and Pisula W., *Impact of Interfacial Microstructure on Charge Carrier Transport in Solution-Processed Conjugated Polymer Field-Effect Transistors*, *Adv. Mater.*, 2016, 28: 2245-2252.
 - Janasz L., Luczak A., Marszalek T., Dupont B. G. R., Jung J., Ulanski J., and Pisula W., *Balanced Ambipolar Organic Field-Effect Transistors by Polymer Preaggregation*, *ACS Applied Materials & Interfaces*, 2017 9 (24), 20696-20703
 - Chapran M., Pander P., Vasyliya M., Wiosna-Salyga G., Ulanski J., Dias F., Data P., *Realizing 20% External Quantum Efficiency in Electroluminescence with Efficient Thermally Activated Delayed Fluorescence from an Exciplex*. *Acs Applied Materials & Interfaces* 2019, 11 (14), 13460-13471
- Patents:
 - Method for fabrication of organic semiconductor/dielectric composite, 29.08.2014, P.217785
 - New compounds, tetrafunctional azaacenes, method of their preparation and their application, 31.12.2013, P.215602
 - Method of producing organic ambipolar layer in organic field effect transistors, 22.01.2021, P.236348
 - Method of producing hybrid dielectric layers intended for use in organic field effect transistors, 29.01.2021, P.236422
 - Organic field effect transistor with insulated gate, 29.08.2014, P.217791
 - Method for fabrication of an organic ambipolar layer, 28.04.2017, P.225444
 - Organic light-emitting diodes with novel emission layers, 11.08.2021, 239386
- Awards: Lodz City Council Award to: Jacek Ulański, Beata Łuszczynska and Jarosław Jung awarded by the City Council to the research team that contributed to the creation of the innovative Organic Electronics Laboratory in BioNanoPark,
- Projects (currently ongoing):
 - "Modification of electrode surfaces with new perylene derivatives and study of electrode-semiconductor interfaces in printed organic optoelectronic devices" - Project OPUS-20/UMO/2020/37/B/ST5/03929 carried out in consortium with University of Lodz and Adam Mickiewicz University in Poznan,
 - "Hybrid graphene-transition metal oxide system: synthesis and application as anode and cathode in organic light emitting diodes" OPUS 11 NCN, UMO-2016/21/B/ST5/00984, realised in consortium with the University of Lodz and the Institute of Electronic Materials Technology in Warsaw,
 - "Ultra-thin transistors based on self-supporting dielectric/semiconductor composites for use as a basic element in the design of flexible electronic circuits" - First Team project funded by the Foundation for Polish Science, No POIR.04.04.00-00-3ED8/17-00
 - "New polymeric photodetectors for Vis-NIR range - synthesis of new semiconductors and optimization of photodetector performance", project in collaboration with the People's Republic of China funded by NAWA, PPN/BCN/2019/1/00031/U/00001,
 - "Organic semiconductors in flexible electronics" - OPUS 17 NCN project, UMO-2019/33/B/ST3/01550,
 - European Centre for Nanostructured Polymers (ECNP)
 - National Laboratory of Photovoltaics

keywords:

organic semiconductors, thin films, , characterisation of thin films and devices, organic light emitting diodes (OLEDs), organic photovoltaics (OPVs), organic photodiodes (OPDs) and organic field effect transistors (OFETs).

List of internship proposal in this research team:

- Development of a method for printing multilayer systems,
- Photophysical characterisation of printed quantum dot emission layers,
- Investigation of the properties of organic electronics devices by impedance spectroscopy,
- Study of elastic characteristics of OFET transistors under bending stress.