

REGISTRATION FORM

This is a registration form for Host Institutions wanting to establish a Dioscuri Centre of Scientific Excellence within Dioscuri 4 call.

1. Research institution data:

Łukasiewicz Research Network – PORT Polish Center for Technology Development,
Sieć Badawcza Łukasiewicz – PORT Polski Ośrodek Rozwoju Technologii
Stabłowicka 147, 54-066 Wrocław, PL

2. Type of research institution¹:

Institute of Łukasiewicz Centre

3. Head of the institution:

Dr. Andrzej Dybczyński, Director

4. Contact information of designated person(s) for applicants and the NCN:

Beata Lubicka, International Project Specialist, beata.lubicka@port.lukasiewicz.gov.pl tel. 727665560, Sieć Badawcza Łukasiewicz – PORT Polski Ośrodek Rozwoju Technologii ul. Stabłowicka 147, 54-066 Wrocław, PL

5. Research discipline in which the strong international position of the institution ensures establishing a Dioscuri Centre:

Natural Sciences and Technology, Materials

¹ As specified in “Addressees of the call”

6. Description of important research achievements from the selected discipline from the last 5 years including a list of the most important publications, patents, other:

a) Selected Publications:

- 1) S.K. Kabali, M. Kondratowicz, T. Lis, P.J. Chmielewski, J. Cybińska, et al. *Lemniscular [16]cycloparaphenylene: a radially conjugated figure-eight aromatic molecule*. Journal of the American Chemical Society, 2019, 141, 7421-7427, IF: **14.695**, [10.1021/jacs.9b01797](https://doi.org/10.1021/jacs.9b01797)
- 2) R. Petrus et al., *Magnesium and zinc alkoxides and aryloxides supported by commercially available ligands as promoters of chemical transformations of lactic acid derivatives to industrially important fine chemicals*, Coordination Chemistry Reviews, Vol. 396, (2019), Pages 72-88, IF **13.476**
- 3) M. Navakouski, H. Zhylitskaya Halina, P.J. Chmielewski, T. Lis, J. Cybińska, M. Stępień *Stereocontrolled synthesis of chiral heteroaromatic propellers with small optical bandgaps*. Angewandte Chemie-International Edition, 2019, 58, 4929-4933, IF: **12.257**, [10.1002/anie.201900175](https://doi.org/10.1002/anie.201900175)
- 4) K. Prorok et al. *Energy Migration Up-conversion of Tb³⁺ in Yb³⁺ and Nd³⁺ Codoped Active Core/Active-Shell Colloidal Nanoparticles*, Chemistry of Materials (2016) 28, 7, 2295-2300, IF **10.159**
- 5) Zhylitskaya Halina, Cybińska Joanna et al., *Bandgap engineering in π -extended pyrroles : a modular approach to electron-deficient chromophores with multi-redox activity*. Journal of the American Chemical Society, 2016, 138, 11390-11398, IF: **13.858**, [10.1021/jacs.6b07826](https://doi.org/10.1021/jacs.6b07826)

b) Selected patents:

In cooperation with 732 scientists from Wrocław and Poland, 152 Research & Development projects have been implemented at Łukasiewicz – PORT in the nano and biotechnology fields. As the result, 95 Polish and 30 European patent applications have been prepared. So far 72 patents have been granted including 26 European and 4 American ones. Exemplary patents in the area of Materials: EP3008734, X-ray memory as well as its use, pending - P.415147, Method of producing a microfluidic channel for fluorescence microscopy on a chip - P.428721, Method for producing planar photonic two- and three-dimensional structures - PL227186, Method for gas detection and location and the system to execute this method - PL222531, A method and system for color marking of metals - PL224641, Al InGaN-based superluminescent diode - PL218578, Luminescent material and the use thereof - PL218302, A method of manufacturing foamed, amorphous, non-flammable insulating materials - PL229185, Method for producing semi-transparent luminescent layer doped with ions rare-earth elements and the luminescent layer, pending: - P.412006, A method for the functionalization of luminescent crystallites of NaYF₄ - P.415133, A method of synthesis and purification of gold nanoclusters with fluorescent properties and their application for biomolecule labeling.

c) **Scientific career:** since 2015 the seven habilitations were achieved thanks to realizing PORT's scientific projects and by Łukasiewicz – PORT researchers.

d) **Other scientific achievements:**

- Pre-ATAM 2020. Organization of the International **Prequel Symposium on Advanced Technologies and Materials** on development on efficient Optical materials, 2D layers and miniaturized photonic devices.
- Co-organization (with INTiBS PAN) of the 1st Conference and Spring School on Properties, Design and Applications of Upconverting Nanomaterials 2016, Wrocław.
- Organization of the international REMAT Conference (2015) and Co-organization the International Conference on Luminescence in the field of geology, rare earth, luminescence for >700 scientists in total.
- Invited lectures of Prof. Shuji Nakamura (Nobel Prize 2014) and Prof. Shin-ya Koshihara, (winner of the Humboldt Research Award 2014).

- Award for Prof. D. Hommel – the Scientist of the Future Polish Award of Smart Development 2019.
- BRUSSELS INNOVA International Fair: 1) Gold medal with distinction "Polymer microstructural fibers" (Prof. W. Urbanczyk), 2) Silver medal "Electromagnetic isolation pianosilicate" (Prof. D. Hreniak), 3) Silver medal – "microporous material for fibers and foil" (Prof. J. Janicki).
- **Prizes for young scientific researchers:** Gold medal in Chemistry given by Physical Chemistry Institute PAN for 2019 to student Kacper Prokop finalist.

7. List of no more than 3 important research projects from the selected discipline awarded in national and international calls to the institution in the last 5 years (title, name of PI, source of funding, amount of funding):

- 1) Program GRIEG, ***2D MXenes based anode materials for all-solid-state Li-ion batteries*** is financed Norwegian Financial Mechanism for 2014-2021 in total amount of € 1,5 mil for 2020 – 2023. The main goal of this project is to gain fundamental insight, identify and unravel the atomistic factors governing structure evolution in 2D transition metal carbides (TMCs/MXenes) during lithiation and de-lithiation using novel real-time characterization at the nanoscale. To achieve this goal, in this project we aim to develop chemical vapor deposition (CVD) growth methods for the synthesis of Mo₂C, V₂C Cr₂C and Ti₂C 2D MXenes. Fundamental studies using in-situ (S)TEM and near in-situ XPS will be performed to gain deeper understanding of CVD growth mechanisms. Process methodologies based on FIB-SEM will be developed to precisely micro-manipulate 2D MXene layers. The electronic structure/states of as grown MXenes as a function of thickness and upon reducing and oxidizing conditions will be studied by in-situ and near situ by EELS and XPS. And then we intend to integrate and fabricate MXenes based full micro-sized all-solid-state batteries (ASSBs) by FIB-SEM on MEMS TEM chips for in-situ (S)TEM investigations to study atomic structural changes in MXenes and at their interface with the solid electrolyte.
- 2) **FNP Team Net - *Hybrid sensor platforms of integrated photonic systems based on ceramic and polymer materials***, is financed from ERDF by the Foundation for Polish Science in amount of €3,15 mil for (2019-2022). Main goal of the project is to create a research network of facilities specialized in integrated optics. In this project we propose the creation of a competence integration mechanism and an universal platform based on newly explored hybrid materials. Basis of these materials are going to be silica compounds with addition of e.g. TiO₂, SnO₂, used as structural matrixes, polymer coatings with additives (active or protective layers), organic and active two-dimensional materials such as transition metal dichalcogenides, graphene hybrids and boron nitride. All of those materials demonstrated unique structural, optical and electric properties in previous studies. Project will involve production and characteristics of materials, technology, design and creation of active and passive elements.
- 3) **FNP Team Tech - *New efficient deep-UV emitters for Life Science Application***, this prestigious project is financed from ERDF by The Foundation for Polish Sciences, the amount € 0,83 mil. This Team-Tech is aiming to develop the technology of efficient UV-LED emitters, which will be done in collaboration with industrial partner (Philips Lighting Poland). Works on UV-LEDs are motivated by many applications of UV emitters including the air and water purification. Results obtained within this Team-Tech project especially concerning novel ideas on p-doping should also find their way to the next generation of shorter wavelengths InGaN/GaN based blue-green emitters. In the context of Team-Tech call it is important to underline that researches of InGaN LEDs after the inventions of Shuji Nakamura have opened new sectors in the industry i.e. the energy efficient, Solid State Lighting (SSL). We are fully convinced that the same story will come up with UV emitters including LEDs and in the future UV laser diodes (LDs). The last ones are much more

challenging and will be not developed within this project but they can be developed in a longer time perspective by the research team created within this project.

8. Description of the available laboratory and office space for the Dioscuri Centre:

Łukasiewicz Research Network – PORT Polish Center for Technology Development is a unique institution, built on the largest infrastructural project in Poland in the R&D area with over 23.000 m² of fully-equipped laboratory and office space. PORT Institute is focused on basic research and development open to welcome collaborations and joined research with industrial partners. The two research centres embrace fully equipped and dedicated for: nucleic acid analysis, microbiology, cell biology and signalling, light and electron microscopy, histology, radioisotopic analysis, protein biochemistry and analytical chemistry. The list of laboratories includes: Bioimaging, Cell Culture, DNA Analysis, Elemental Analysis, Flow Cytometry, Infrared Spectroscopy, Mass Spectrometry and Chromatography, Microbiology, Molecular Interactions, Nanobioengineering, Nuclear Magnetic Resonance, Virology and Cell Biology. In the accredited laboratories of Materials Engineering Center a number of tests and analyses can be performed, they relate to both qualitative tests confirming the identity of organic compounds or chemicals and quantitative research, which involves, determining the purity of organic compounds by NMR. Electron Microscopy Laboratory is the only unit in Poland offering a unique method to determine the purity of standards or chemical reagents in a wide range of contents, as well as in the pharmaceutical industry to identify known and new active substances.

For the Dioscuri Łukasiewicz - PORT will offer:

- a) Open-space laboratories dedicated for establishing new research groups
- b) Modern, fully furnished office ranging from 15 to 45 m²
- c) Fully equipped, specialized laboratories, dedicated for organic and inorganic synthesis, clean synthesis and characterisation of novel materials with special properties, mainly Laboratories:
 - I. Electron Microscopy,
 - II. Polymer Materials,
 - III. Optical Spectroscopy,
 - IV. Functional Materials Synthesis,
 - V. Materials Technology,
 - VI. Structures And Materials Research,
 - VII. Laser Technology.

Services we offer in the laboratories:

- Designing, synthesis and bio-functionalization of materials with luminescent properties and a comprehensive characterization of their structure and composition. These materials in the form of powders, solutions, or thin films are applicable in different areas, from modern lighting (e.g. of LED type), through anti-counterfeiting marking, to advanced medical technologies. It is possible to synthesize organic compounds, rare earth based complexes and materials, as well, as nanoparticles. Full spectroscopic characterization and quantitative analysis of obtained substances can be made.
- Fabrication of epitaxially grown nitride materials for optical, electronic and magnetic applications as well as for basic research. Development and supply of optically active and magnetic materials on substrates up to 4 inch diameter. State of the art in-situ characterization tools provide high

reliability and reproducibility of sample properties. Analysis can be done after growth or on any externally introduced sample.

9. List of the available research equipment for the Dioscuri Centre:

Below listed equipment will be available to the Dioscuri Leader accordingly to the scope and Research Agenda for the Dioscuri Centre.

I. Structures And Materials:

Molecular beam epitaxy system (MBE) System
Metal-organic chemical vapour deposition (MOCVD) System
Atomic force microscope (AFM)
X-ray photoelectron spectroscopy (XPS)
WAXS/SAXs X-Ray diffractometer (Pananalytical Empyrean)
Single crystal diffractometer (Agilent technologies)
SEM/FIB microscope with EDS (FEI Helios Nanolab 450HP)
TEM microscope (FEI Tecnai G2 X-Twin)
HR-TEM Microscope (FEI Titan G2 60-300) and spectrometer EELS
Devices and accessories for sample preparation for light, scanning and transmission microscopes
Micromachining system with picosecond laser, Micromachining systems with Excimer laser
Micromachining system with fiber laser and CO₂ laser
NMR 600MHz (Bruker), ICP-OES

II. Optical Spectroscopy:

Fluorescence spectrometers (Edinburgh instruments)
Spectrophotometers (Evo 300, Thermo Scientific)
FT-IR Spectrometer (Nicolet is50, Thermo Scientific)
Spectrometer MALDI Autoflex III TOF/TOF (Bruker)
Atomic absorption spectrometer (SavantAAS, GBC)
Microwave reactors
High-pressure reactors for syntheses
Glove boxes
Automatic Soxhlet Extractor
Spray dryer, Vacuum dryer
Liophilizers, Homogenizers

III. Polymer Materials:

Thermal analyzer (Netzsch STA 449 F1 Jupiter; Bruker FTIR Tensor 27; QMS Aeolos)
High temperature dilatometer DIL (Netzsch DIL 402C)
Thermal diffusivity analyzer LFA (Netzsch LFA 457 MicroFlash)
Thermal conductivity analyzer HFM (Netzsch HFM 436 Lambda)
Dielectric analyzer DEA (Netzsch DEA 288 Epsilon)
Differential scanning calorimeter with modulated temperature MT-DSC (Mettler-Toledo DSC1)
Thermogravimetric analyzer TG (Mettler Toledo TGA2)
Dynamic-mechanical-analyzer DMA (Mettler Toledo DMA/SDTA 861)
Thermo-mechanical analyzer TMA (Mettler Toledo TMA/SDTA1 LN 600 i TMA/SDTA 1 LF 1100)
Physisorption analyzer (Micromeritics 3Flex)
Chemisorption analyzer (Micromeritics AutoChem II)
Goniometer OCA 35 (DataPhysics)
Tensiometer DCAT11 (DataPhysics)

Zetasizer Nano range analyzer (Malvern ZS)
Aging tests chambers

IV. Laser Technology:

High precision ink-jet printer PiXDro LP50
High precision dispensing robot Fisnar F4200N
Laboratory Setup for inks fabrication
System for current-voltage measurements
System for measurement of spectral response of solar cells
System for electrochemical measurements
Tabletop system transmission and reflection of thin films
Ageing and UV chambers
Glove boxes

10. List of the additional benefits (other than listed in call text) that the Institution declares to provide for the Dioscuri Centre (i.e.: additional funds, personal benefits, other):

PORT's strategy and organizational rules facilitate the high degree of novelty approaches in research and efficient transfer of research results into innovative future technologies. The location of PORT is absolutely unique; in historical, green **Campus Prace**: 11 000 m² of lab space on 27 ha of campus area, 100 ha of an area surrounding the Campus, intended by the city of Wroclaw for R&D investments, 13 km from the centre of Wroclaw, **dedicated parking lot**, and an old park nearby, excellent communication thanks to the proximity of motorway bypass, airport and train station 100 meters from the campus.

In order to best facilitate and increase the success of sustainable operation of the Dioscuri Centre **PORT declares the following organizational and scientific benefits for the Leader:**

- a) Supporting the on-boarding installation and start-up package for the lab.
- b) The organizational support from HR in the adaptation to the new environment and the personal assistance to help in understanding the organization. HR will assist in relocating, setting of formalities in Polish offices, banks and other institutions, finding accommodation and leisure activities.
- c) Support in selection and supervision of other team members, in line with the profiles needed to conduct the research and in accordance with Code of Conduct for the Recruitment of Researchers HR excellence rules and institution management practices;
- d) Organization of international science and business oriented conferences as well as science promoting events.
- e) The organization support in obtaining the international grants from Horizon Europe as well as local, Polish funding programs. Supporting of Submitting applications, building scientific collaborations and relations with Hi-Tech SMEs. eg. XTPL, SDS Optic, Advanced Graphene Products, WABCO.
- f) Project management; financial reporting, project administration according the implemented methodology (PRINCE2 modified with the institution's own solutions) at every stage of a project.

The support includes also documentation of the progress (milestones and expenses) the risks management, contingency plans, and application of the adequate financial procedures.

- g) Commercialization of research results, building the IPR portfolio of complementary projects and creating a foundation for innovative application solutions, long-term investment based on demonstrators and cooperation with big companies.
- h) The Institute Council with a senior advisory role composed of 12 international members. The Council will be, representing business, academia and public domain. As Łukasiewicz - PORT aspire to build world-class institution, Council shall represent two major fields of the Institute's areas of interest - biotechnology and materials engineering.

11. Other information about the internationalisation of the research institution, international researchers employed at the institution, the availability of English language seminars etc.:

- Łukasiewicz - PORT (former Wrocław Research Centre EIT+) has been seeking international dimension by gaining international staff. Internal (English language) scientific seminars and invited lecture seminars are carried out weekly. Representatives of each of the 2 scientific centers cover topics of Life sciences and biotechnology, nanotechnology and engineering. Most of scientific groups leaders used to work abroad worldwide for a few years, before joining Łukasiewicz - PORT and invite their colleagues as guest lecturers. Internal scientific seminars and invited lecture seminars are presented in English weekly.
- Prof. from University of Bremen has been invited to build the Nanotechnology Department in WRC EIT+ and since 2019 Łukasiewicz - PORT has been leading the scientific groups. Also other scientists from the University of Bremen were involved in launching the Laboratory of Epitaxial Semiconductor Compounds. PhD student, conducted research into a doctoral thesis based on the PioneerGaN project. In 2016, as part of cooperation with the IMEC Interuniversitat Micro-Electronics Centrum, the project "New nitride based materials and hybrid solutions for short-wavelength technologies in industrial application" was prepared for the FNP competition for the International Research Agenda worth PLN 35 million. The application has passed to the second stage of the assessment of international experts. In 2019 Prof. submitted the application for the ERC Advanced grant.
At the moment, the institute employs: 2 experienced scientists who returned to Poland this year from the University of Strasbourg and the Max Planck Institute in Munich and headed two research groups at PORT. The Institute employs 7 foreigners from the following countries: 2 from India, 2 from France, 2 from Ukraine and Belarus.
- In 2017 the Institute invited to the Laboratory of Electron Microscopy, a researcher from the University of Oslo, who obtained the finances for his research from the Polonez-1 program of the Polish National Science Centre and realizes the project on "Atomic scale study of emerging UV-light LEDs by advanced transmission electron microscopy".
- In 2019 a researcher moved to PORT from Université de Strasbourg, CNRS, Institut de Science et d'Ingénierie Supramoléculaires to realize project: Sequence-defined macromolecules of controlled folding. She is also a scientific expert for The National Centre for Research and Development.
From 2015 Łukasiewicz - PORT has been actively participating in two COST networks:
 - COST The European Upconversion Network From the Design of Photon-upconverting Nanomaterials to (Biomedical) Applications - CM1403
 - COST Action MP 1307: stable Next-Generation Photovoltaics: Unraveling degradation mechanisms of Organic Solar Cells by complementary characterization techniques (StableNextSol)

- Łukasiewicz - PORT has gained the experienced in European science networking and the Cooperation on the European scale through H2020 initiative EIT European Institute of Innovation and Technology and KIC RAW Materials (Knowledge Innovation Community) - The EIT's innovation partnership that bring together businesses, research centers and universities. The institute has been involved in the application as a co-founder of the consortium of 116 partners and the founder of the Eastern Collocation Centre of KIC RM located in Łukasiewicz - PORT.
- RawMaterials Academy was initiated by EIT KIC RM. The innovative educational projects are conducted as part of the Academy, which are addressed to doctoral students, students, industrial partners, specialists from the raw materials sector and a broad society. Training, workshops and conferences support new ways of teaching by linking academia environment, research organizations and industry.
- WRC EIT + Łukasiewicz - PORT was a Partner of the 4th edition of the MIT Enterprise Forum Poland.