

Registration form for Polish research institution

1. Research institution data (name and address):

Jerzy Haber Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences

ul. Niezapominajek 8, PL-30239 Krakow, Poland

2. Type of research institution:

2) research unit of the Polish Academy of Sciences

3. Head of the institution:

prof. dr hab. Małgorzata Witko, member of Polish Academy of Sciences, member of Academia Europea, dr.h.c.

4. Contact information of designated person(s) for applicants and the NCN: first and last name, position, e-mail address, phone number, correspondence address):

Prof. dr hab. inż. Piotr Warszyński, head of „Soft Matter Nanostructures” Research Group

e-mail: ncwarszy@cyf-kr.edu.pl, phone: +48126385223

correspondence address: Jerzy Haber Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences

ul. Niezapominajek 8, PL-30239 Krakow, Poland

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

Natural Sciences and Technology

Materials and synthesis

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 (up to one page in A4 format):

We have developed an efficient method for formation of polymeric nano- and microcapsules for the encapsulation of various active compounds including corrosion inhibitors. The microcapsules could be embedded into epoxy coating to obtain self-healing effect. Moreover, we developed the methodology of producing of thin functional films for

preventing biofilm formation, antibacterial coatings, conductive films for electrochemical sensors. Additionally, within EU project, we developed the method of bonding of microelectronic elements.

Selected patent applications filed in 2013-2018:

REDFORD K, KRISTIANSEN H, SUGDEN M, TILSET B G, WARSZYNSKI P, LIU C, WHALLEY D, HUTT D, Method for forming bonded assembly to make electronic product for LCD applications, involves pressing substrates together to compress balls and form assembly, and fixing geometry of assembly by bonding assembly to form bonded assembly, WO2015091673-A1 ; GB2523983-A

BRUNSCHWILER T J, BURG B, DIXON R, KRISTIANSEN H, WARSZYNSKI P, ZUERCHER J, „Bridging arrangement for use in microelectronic component, has particles for defining path between first and second surface, bridging gap“, GB2531760-A ; US2016126202-A1

Selected publications in the field of functional coatings published in 2013-2018:

K. Szczepanowicz, T. Kruk, W. Świątek, A. M. Bouzga, C. R. Simon, P. Warszyński, „Poly (l-glutamic acid)-g-poly (ethylene glycol) external layer in polyelectrolyte multilayer films: Characterization and resistance to serum protein adsorption“, *Colloids and Surfaces B: Biointerfaces* 166, 2018, 295-302, 10.1016/j.colsurfb.2018.03.020

T. Kruk, K. Szczepanowicz, D. Kręgiel, L. Szyk-Warszyńska, P. Warszyński, „Nanostructured multilayer polyelectrolyte films with silver nanoparticles as antibacterial coatings“, *Colloids and Surfaces B: Biointerfaces* 137 (2016) 158-66 , doi:10.1016/j.colsurfb.2015.06.016

W. Dec, M. Mosiałek, R. P. Socha, M. Jaworska-Kik, W. Simka, J. Michalska, „The effect of sulphate-reducing bacteria biofilm on passivity and development of pitting on 2205 duplex stainless steel“, *Electrochimica Acta*, 212, (2016), 225-236, doi: [10.1016/j.electacta.2016.07.043](https://doi.org/10.1016/j.electacta.2016.07.043)

M. Kopeć, K. Szczepanowicz, P. Warszyński, P. Nowak, “Liquid-core polyelectrolyte nanocapsules produced by membrane emulsification as carriers for corrosion inhibitors”, *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 510, (2016), 2-10, doi: 10.1016/j.colsurfa.2016.08.056

M. Kopeć, K. Szczepanowicz, G. Mordarski, K. Podgórna, R. P. Socha, P. Nowak, P. Warszyński, T. Hack, „Self-healing epoxy coatings loaded with inhibitor-containing polyelectrolyte nanocapsules“, *Progress in Organic Coatings* 84 (2015) 97–106 doi:10.1016/j.porgcoat.2015.02.011

T. Kruk, K. Szczepanowicz, J. Stefanska, R. P. Socha, P. Warszyński, „Synthesis and antimicrobial activity of monodisperse copper nanoparticles“, *Colloids and Surfaces B: Biointerfaces* 128 (2015), 128, 17–22 doi:10.1016/j.colsurfb.2015.02.009

A. Pajor-Świerzy, T. Kruk, P. Warszyński, „Enhancement of the Electrocatalytic Properties of Prussian Blue Containing Multilayer Films Formed by Reduced Graphene Oxide“, *Colloids and Interface Science Communications*, 1, 2014, 6-9. DOI: 10.1016/j.colcom.2014.05.001

M. Plawecka, D. Snihirova, B. Martins, K.Szczepanowicz, P. Warszynski, M.F. Montemor, „Self healing ability of inhibitor containing nanocapsules loaded in epoxy coatings applied on aluminium 5083 and galvanized substrates“, *Electrochimica Acta*, 140, 2014, 282-295. DOI: 10.1016/j.electacta.2014.04.035.

Z. Tabor, P. Warszynski, „Modeling dissolution controlled release of inhibitor from a damaged coating“, *Corrosion Science*, 82 (2014) 290–296, DOI: 10.1016/j.corsci.2014.01.026.

A.Pajor-Świerzy, M. Kolasińska-Sojka, P. Warszynski, “The electroactive multilayer films of polyelectrolytes and Prussian Blue nanoparticles and their application for H₂O₂ sensors”, *Colloid and Polymer Science*, 292(2) (2014) 455-465; DOI 10.1007/s00396-013-3091-x

K. Drabczyk, R. Socha, P. Panek, G. Mordarski, "Electrodeposition of thin metallic layer for solar cell electrodes", *Soldering & Surface Mount Technology*, 26, (2014) 8-21, doi:10.1108/SSMT-10-2013-0032

Z. Tabor, P. Nowak, M. Krzak, P. Warszynski, Effective diffusivity in transient state, *J. Chem. Phys.* 139, 074903 (2013); DOI:10.1063/1.4818579

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):

[2013-2016] “Functional joining of dissimilar materials using directed self-assembly of nanoparticles by capillary-bridging”, prof. Piotr Warszynski, 7PR EU, 331 577 EUR

[2013-2016] “Nanoparticulate delivery systems for therapies against neurodegenerative diseases”, prof. Piotr Warszynski, Polish-Norwegian Research Programme, funds total: 3,919,041 PLN, funds for ICSC PAS: 787,812 PLN

[2014-2016] “In-line processing of n+/p and p/p+ junction systems for cheap photovoltaic module production”, prof. Piotr Warszynski, Polish-Norwegian Research Programme, funds total: 3 713 248 PLN, funds for ICSC PAS: 766,400 PLN

[2016-2019] “Theranostic nanocarriers for MRI imaging”, prof. Piotr Warszynski, NCN, Funds total: 832 800 PLN

[2018-2020] „Badania nad formulacją i technologią nakładania nowej, antykorozyjnej, lakierniczej powłoki proszkowej w celu wydłużenia cyklu życia produktów metalowych w trudnych warunkach klimatycznych”, prof. Piotr Warszynski, Małopolska Regional Funds, Funds ICSC: 719 550 PLN

8. Description of the available laboratory and office space for the Dioscuri Centre (up to one page in A4 format):

The Dioscuri Centre will use an existing laboratories of ICSC PAS, which are devoted to synthesis of microcarriers and corrosion research. The laboratory rooms are 40 sq m large and are well equipped with general laboratory devices (technical gases installations, vacuum hood) and bench space. Basic laboratory materials (e.g. general reactants) and consumables (e.g. laboratory glass) are already in place. The Dioscuri Centre will have access to all scientific instruments available at ICSC PAS (see below).

The office space of the head of the Dioscuri Centre will be a 20 sq m office room equipped with appropriate furniture, phone and personal computer with internet connection. Additional office space will be available for Dioscuri research personnel, depending on the needs of the Centre. The Institute has a valid subscription to major scientific literature data bases (e.g. Web of Science, Scopus) and a wide spectrum of scientific literature is available in an electronic form. The Institute library has a rich collection of scientific books and periodicals.

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

The Institute is well equipped with up-to-date instruments for research in the field of catalysis, such as:

- a number of gas and liquid chromatographs of different types equipped with various detectors (also with mass spectrometers), some of them connected on-line to catalytic apparatus;
- high class spectrometers of different types and ranges (FT-IR of full range, UV-Vis, micro-XRF, ICP-OES, solid-state NMR, spectrofluorimeter) many of them with a broad selection of additional devices;
- installations for carrying catalytic tests in different scale and conditions (also at high pressure);
- microscopes: ultra high resolution Field Emission Scanning Electron Microscope JEOL JSM-7500F and AFM-NT-MDT with "Olympus" optical microscope, ZEISS Confocal microscope;
- surface area and pore size analyzers capable of measuring physisorption and chemisorption: BET surface area and N₂ adsorption isotherms analyzer, microbalance for thermogravimetric gas and vapour sorption analysis, surface area and pore size analyzers, vacuum microbalances, water sorption analyser;
- microparticle size (DLS, Laser diffraction) and zeta potential (LDV) analysers;
- thermal analysis and calorimetric equipment: evolved gas analysis by mass spectrometry equipment (home made with quadrupole mass spectrometer (MS EGA), home made TPD equipment, Microscal gas flow-through microcalorimeter, simultaneous DSC/TG analyzer;

- equipment for structural analysis: powder X-ray diffractometer Siemens D5005 equipped with reaction chamber and grazing incidence attachment, powder X-ray diffractometer X'PERT PRO MPD;
- devices for surface nanostructures and thin films analysis: quartz crystal microbalance QS-E4 with Q-sense window module, spectroscopic imaging ellipsometer, surface potential sensor for surface potential measurements by using vibrating plate method;
- ultra-high-vacuum systems for surface science analysis (two multi-chamber analytic systems dedicated to surface and functional nanostructure studies STM/AFM/LEES/AES/XPS/UPS base pressure $<1 \times 10^{-9}$ Pa);
- apparatus for electrochemical, photochemical and photoelectrochemical measurements in catalytic systems;
- equipment for theoretical calculations: computer cluster of 356 CPU and 6 GPU cores (NVIDIA CUDA GPU).

Access to Polish National Synchrotron Radiation Facility SOLARIS (administered by Jagiellonian University) is also available. The PEEM/XAS experimental line of SOLARIS is operated within a cooperation between the Institute, SOLARIS and AGH University of Science and Technology.

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) (up to one page in A4 format):

PhD Studies affiliated at the Institute, which have been awarded the “Chemistry Doctorate Eurolabel” by the European Chemistry Thematic Network, and various interdisciplinary PhD projects in which the Institute participates make the Institute benefits from a steady inflow of young researchers.

Subsidized theater and philharmonic tickets and subsidized access to sport facilities are available for all employees.

11. Other information about the internationalisation of the research institution, international researchers employed at the institution, the availability of English language seminars etc. (up to one page in A4 format):

ERASMUS+

The Institute participates in the ERASMUS+ network and both PhD students and employees benefit from research and training visits at foreign research institutions financed by this network. In addition, the Institute regularly hosts visiting students from abroad.

International cooperation

The Institute has a long standing tradition of both national and international cooperation. The international contacts manifest in numerous joint research projects realized by ICSC PAS (e.g. projects of EU Framework Programmes: [2008-2013] NEXT-GTL "Innovative Catalytic Technologies & Materials for Next Gas to Liquid Processes", EC 7th FP CP-IP 229183-2, [2009-2013] F3 "Factory Flexible, Fast and Future Factory - European Chemistry Consortium Begins the Journey into the Future of Production", EC 7th FP CP-IP 228867-2, EC [2012-2015] NanoEIS "Nanotechnology Education for Industry and Society", 7th FP CSA 319054, [2013-2015] HYPERCONNECT "Functional Joining of Dissimilar Materials Using Directed Self-assembly of Nanoparticles by Capillary-bridging", EC 7th FP 310420, and projects of the Polish-Norwegian Research Programme: [2013-2016] NanoNeucar "Nanoparticulate Delivery Systems for Therapies against Neurodegenerative Diseases" (core), [2013-2016] InlinePV "In-line Processing of n+/p and p/p+ Junction System for Cheap Photovoltaic Module Production", [2013-2015] FUNClay "Synthesis and Functionality of Innovative Porous Clay Hybrid Nanostructures"), coordination and participation in COST actions (Chair of the Action: [2012-2016] "Colloidal Aspects of Nanoscience for Innovative Processes and Materials" EU COST Action CM1101), numerous bilateral agreements and very many informal collaborations. All sorts of international collaborations result in ca. 35 scientific papers published each year with co-authors from abroad.

International conferences organized by ICSC PAS

The Institute regularly organises international conferences in the field of catalysis and surface chemistry. As the most recent examples may serve: International Conference on Catalysis and Surface Chemistry 2018, 8th World Congress on Oxidation Catalysis 2017, European School on Interfacial Engineering: Fundamentals, Applications, and Analytical Methods ESIE 2017, 16th International Conference on Theoretical Aspects of Catalysis ICTAC-16 2016, 4th, 5th, and 6th Meeting 'X-ray and other techniques in investigations of the objects of cultural heritage' 2012, 2014, 2016, 15th European Student Colloid Conference 2015, 3rd, and 4th International Symposium on Surface Imaging/Spectroscopy at the Solid/Liquid Interface 2012, 2015, 8th, and 9th International Symposium „Surface Heterogeneity Effects in Adsorption and Catalysis on Solids 2012, 2015, International Symposium on Air & Water Pollution Abatement Catalysis 2014, 5th International Workshop Bubble and Drop Interfaces B&D 2012.

The Institute often hosts visiting professors from abroad, who give lectures or seminars (in English) that are open for the whole scientific community in Krakow. The Institute successfully attracts post-doctoral fellows from abroad (recently from Germany, UK and India).