

## Expression of interest for research cooperation

### Description of institution

Interested institution:	<b><u>Institute of Biotechnology, University of Rzeszów</u></b>
Department carrying out the proposed research	<b><u>Department of Medicinal Chemistry and Nanomaterials</u></b>
Address and webpage	address: Pigońia 1a, 35-310 Rzeszów, Poland  <a href="http://www.ur.edu.pl/wydzialy/pozawydzialowy-instytut-biotechnologii">http://www.ur.edu.pl/wydzialy/pozawydzialowy-instytut-biotechnologii</a>
Contact person (name, e-mail address, phone)	Robert Pazik PhD. DSc  <a href="mailto:r.pazik@int.pan.wroc.pl">r.pazik@int.pan.wroc.pl</a>

### Research offer

#### Brief description of the department (key research facilities, infrastructure, equipment)

(up to 1000 characters)

Members:

Dariusz Pogoćki, PhD. DSc., Robert Pązik, PhD. DSc., Joanna Kisała, PhD, Kinga Hęćlik, Msc., Anna Tomaszewska-Pązik, Msc.

Scientific equipment:

- (i) open and pressurized microwave reactor ERTEC V2 Magnum,
- (ii) apparatus for estimation of hydrodynamic size and zeta potential equipped with automatic titration station,
- (iii) two photochemical reactors,
- (iv) two HPLC setups with UV-VIS detection,
- (v) UV-Vis spectrophotometers,
- (vi) computer workstations (summarized double precision performance ca. 3,5 TFlops).

### Scientific area

<input type="checkbox"/> <b>Chemistry</b>	<input type="checkbox"/> Social Sciences and Humanities
<input type="checkbox"/> Economic Sciences	<input type="checkbox"/> Information Science and Engineering
<input type="checkbox"/> Environment and Geosciences	<input type="checkbox"/> Life Sciences
<input type="checkbox"/> Mathematics	<input type="checkbox"/> Physics

### Research field

(up to 500 characters)

Synthesis and characterization of nanomaterials of unique physico-chemical and biological properties.

Application of nanoparticles in various fields of human activity e.g. translational medicine, agriculture and environmental protection.

### The proposed research/project description

(up to 1000 characters)

The main scientific interests are strongly focused on studies of the effect of hydrolytic and non-hydrolytic reaction conditions on structural, luminescence and magnetic properties of complex metal oxide nanoparticles showing prospects in bio-related area. Efforts are directed towards identification of the optimal conditions for fabrication of highly crystalline, biocompatible particles showing luminescence as well as magnetic properties for FI (fluorescence imaging), MRI (magnetic resonance imaging) or MDT (magnetic drug targeting) applications. Nanoparticles surface modification is of interest as well, especially trails allowing for more flexible anchoring of the organic ligands containing phosphate or phosphonate moieties (but not only) leading to the enhancement of particle dispersion stabilization and opening prospects for the use of colloidal suspension of nanoparticles in biomedical applications with improved biocompatibility.

Research plans are already focused on exploration of the dependence of synthetic approaches on physicochemical properties (structure, luminescence, magnetism) of the functional nanoparticle and nanocomposite systems with strong emphasis on new biomaterials and their interactions with biological systems. Development of the complex systems like core-shell structures, composites, inorganic-organic hybrid nanomaterials. Knowledge of the nanomaterials interaction (surface modification, cytotoxicity and etc.) with biomolecules or complex biological media is a key factor in assessment of future high-end applications.

The group initiated a project devoted to the photo-catalysis of organic pollutants (i.e. pesticides as well as other organic matter) by using variety of different nanomaterials showing promising catalytic activity under UV-VIS irradiation.

**Additional information (key Persons and Expertise; additional trainings, research programme, other)**

(up to 1000 characters)

Scientific cooperation:

Prof. Christian Schöneich, Faculty of Pharmaceutical Chemistry, University of Kansas, Kansas USA

Prof. Gordon L. Hug; Prof. Ireneusz Janik. Radiation Laboratory, University of Notre Dame, Indiana USA.

Prof. Vadim Kessler, Department of Molecular Sciences, BioCentrum, SLU, Uppsala, Sweden.

Prof. Jean-Marie Nedelec, Institute de Chimie de Clermont-Ferrand, Universite Clermont Auvergne, Clermont-Ferrand, France

Prof. Przemysław Dereń, Institute of Low Temperatures and Structure Research, Polish Academy of Sciences, Wrocław, Poland

Prof. Wiesław Stręk, Institute of Low Temperatures and Structure Research, Polish Academy of Sciences, Wrocław, Poland

Prof. Krzysztof Rogacki, Institute of Low Temperatures and Structure Research, Polish Academy of Sciences, Wrocław, Poland

Prof. Bogdan Idzikowski, Institute of Molecular Physics Polish Academy of Sciences, Poznan, Poland

Prof. Bronisław Marciniak, Dr. Piotr Filipiak, Faculty of Chemistry. Adam Mickiewicz University, Poznań Poland

Prof. Krzysztof Bobrowski; Prof. Marek Trojanowicz; Dr. Tomasz Szreder. Dr. Jarosław Sadło. Institute of Nuclear Chemistry and Technology, Warsaw Poland.

Dr Gerald Hörner. Institute of Bioorganic Chemistry. Technical University of Berlin, Berlin Germany,

Recent publications:

1. Natural Environments for Nanoparticles Synthesis of Metal, Metal Oxides, Core-Shell and Bimetallic Systems. J. Kisała, K.I. Hęćlik, A. Masłowska, M. Celuch, D. Pogocki, Studies on Natural Products Chemistry. 52, 1-67 (2017)

2. New Insights into the Reaction Paths of 4-Carboxybenzophenone Triplet with

Oligopeptides Containing N- and C-Terminal Methionine Residues. P. Filipiak, K. Bobrowski, G. L. Hug, D. Pogocki, C. Schoneich, B. Marciniak. *Journal of Physical Chemistry*. 121, 5247-5258 (2017).

3. Non-contact  $Mn_{1-x}Ni_xFe_2O_4$  ferrite nano-heaters for biological applications – heat energy generated by NIR irradiation, R. Pązik, E. Zachanowicz, B. Poźniak, M. Małecka, A. Zięcina, Ł. Marciniak, *RSC Advances* 7, 18162-18171 (2017)

4. Essentials and Perspectives of Computational Modeling Assistance for CNS-oriented Nanoparticle-based Drug Delivery Systems. J. Kisała, K. Hęclik, K. Pogocki, D. Pogocki. *Current Drug Metabolism*. submitted (2017).

5. Polyrhodanine cobalt ferrite (PRHD@CoFe<sub>2</sub>O<sub>4</sub>) hybrid nanomaterials - synthesis, structural, magnetic, cytotoxic and antibacterial properties, E. Zachanowicz, J. Pięłowski, A. Zięcina, K. Rogacki, B. Poźniak, M. Thikhomirov, M. Marędziak, K. Marycz, J. Kisała, K. Hęclik, R. Pązik, *Dalton Transactions*, submitted (2017)