

REGISTRATION FORM FOR CZECH SCIENTIFIC INSTITUTION

1. Research institution data (name and address):

University of West Bohemia (UWB)
New Technologies - Research Centre (NTC)

Univerzitní 2732/8
301 00 Plzeň, Czech Republic

2. Type of research institution: Public university (veřejná vysoká škola)

3. Head of the institution:

Assoc. prof. Dr. RNDr. Miroslav Holeček – Rector of the University of West Bohemia
rektor@rek.zcu.cz, +420 377 631 000

Mgr. Petr Kavalíř, Ph.D., MBA – Director of the New Technologies - Research Centre
pkavalir@ntc.zcu.cz, +420 776 368 660

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

prof. Dr. Ján Minár – Head of the Department Research of Advanced Materials (RAM)
jminar@ntc.zcu.cz, +420 735 713 958
Univerzitní 2732/8, 301 00 Plzeň, Czech Republic

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

Natural Sciences and Technology: *Condensed matter physics* - structure, electronic properties, fluids, nanosciences, biological physics

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

- Rienks, E.D.L.; Wimmer, S.; Sánchez-Barriga, J.; **Khan, S. A.; Minár, J.**; Ebert, H. *et al.* Large magnetic gap at the Dirac point in Bi₂Te₃/MnBi₂Te₄ heterostructures. **NATURE** **576**, 423–428 (2019). ISSN: 0028-0836. <https://doi.org/10.1038/s41586-019-1826-7>. **Time cited: 88.**
- Krempaský, J.; Muff, S.; **Minár, J.**; Pilet, N.; Fanciulli, M.; Gmitra, M.; Scagnoli, V.; Springholz, G.; Dil, J. H. *et al.* Operando Imaging of All-Electric Spin Texture Manipulation in Ferroelectric and Multiferroic Rashba Semiconductors. **PHYSICAL REVIEW X** **8**, 2, 021067 (2018). ISSN: 2160-3308. <https://link.aps.org/doi/10.1103/PhysRevX.8.021067>. **Time cited: 26.**
- Virtanen, P.; Gommers, R.; Oliphant, T.E.; **Cimrman, R.** *et al.* SciPy 1.0: fundamental algorithms for scientific computing in Python. **NATURE METHODS** **17**, 261–272 (2020). ISSN: 1548-7091. <https://doi.org/10.1038/s41592-019-0686-2>. **Time cited: 4635.**
- Nemšák, S.; Gehlamann, M.; Kuo, C.T.; Lin, S.C.; Schlueter, C.; Ebert, H.; Di Marco, I.; **Minár, J.**; Schneider, C.M.; Fadley, C.S.: Element- and momentum-resolved electronic structure of the dilute magnetic semiconductor manganese doped gallium arsenide. **NATURE COMMUNICATIONS**, 2018, 9, AUG 17 2018, ISSN: 2041-1723. <https://doi.org/10.1021/acs.nanolett.9b03962>. **Time cited: 12.**
- Beaulieu, S.; **Schusser, J.**; Dong, S.; Schüler, M.; Ebert, H.; Hricovini, K.; Braun, J.; **Minár, J.**; *et al.* Revealing Hidden Orbital Pseudospin Texture with Time-Reversal Dichroism in Photoelectron Angular Distributions. **PHYSICAL REVIEW LETTERS**, 2020, 125, 21. ISSN: 0031-9007. <https://doi.org/10.1103/PhysRevLett.125.216404>. **Time cited: 14.**
- **Kučera, M.; Moskal, D.; Martan, J.**: Method of laser beam writing with shifted laser surface texturing. **PATENT, US10160229**, United States Patent and Trademark Office (USPTO). **2018.**
- Mayorga-Martínez, C.C.; Sofer, Z.B.; Luxa, J.; Huber, Š.P.; Sedmidubský, D.; Brázda, P.; Palatinus, L.; Mikulics, M.; Lazar, P.; **Medlín, R.**; Pumera, M.: TaS₃ Nanofibers: Layered Trichalcogenide for 2 High-Performance Electronic and Sensing 3 Devices. **ACS NANO**, 2018, 12, 1, 464-473. ISSN: 1936-0851. <https://doi.org/10.1021/acsnano.7b06853>. **Time cited: 17.**
- **Deshmukh, K.; Kovářik, T.**; Khadeheer Pasha, S.K.: State of the art recent progress in two dimensional MXenes based gas sensors and biosensors: A comprehensive review. **COORDINATION CHEMISTRY REVIEWS**, 2020, 424, DEC 1 2020. ISSN: 0010-8545. <https://doi.org/10.1016/j.ccr.2020.213514>. **Time cited: 33.**
- **Muzika, L.; Švantner, M.; Houdková Šimůnková, Š.; ŠULCOVÁ, P.**: Application of flash-pulse thermography methods for quantitative thickness inspection of coatings made by different thermal spraying technologies. **SURFACE AND COATINGS TECHNOLOGY**, 2021, 406, JAN 25 2021, ISSN: 0257-8972. <https://doi.org/10.1016/j.surfcoat.2020.126748>.

7. List of no more than 3 important research projects in the selected discipline awarded in national and international calls to the institution in the last 5 years:

Title: CEDAMNF - Computational and experimental design of advanced materials with new functionalities

Name of PI: **prof. Dr. Ján Minár**, University of West Bohemia, Pilsen, Czech Republic

Registration number: CZ.02.1.01/0.0/0.0/15_003/0000358

Provider: Ministry of Education, Youth and Sports, Czech Republic

Programme: Excellent Research Teams, Call number: 02_15_003

Project realization: 01/2017 - 04/2023

Total approved costs: EUR 6 202 425 (CZK 155 060 641)

Title: MP 1306 EUSpec - Modern Tools for Spectroscopy on Advanced Materials: a European Modelling Platform

Name of PI: prof. Hubert Ebert, Ludwig-Maximilians-Universität München, Germany

Leader WG1 - Group 1 - Correlation, **prof. Dr. Ján Minár**, University of West Bohemia, Pilsen, Czech Republic

Registration number: COST Action MP 1306

Provider: European Cooperation in Science and Technology (COST)

Project realization: 03/2014 - 03/2018

Title: LABIR-PAV - Pre-application research of infrared technologies

Name of PI: **prof. Ing. Milan Honner, Ph.D.**, University of West Bohemia, Pilsen, Czech Republic

Registration number: CZ.02.1.01/0.0/0.0/18_069/0010018

Provider: Ministry of Education, Youth and Sports, Czech Republic

Programme: Pre-Application Research for ITI II, Call number: 02_18_069

Project realization: 07/2018 - 12/2022

Total approved costs: EUR 4 103 672 (CZK 102 591 798)

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

SARPES laboratory: UV light Spin- and Angle-Resolved PhotoEmission Spectroscopy (SARPES), X-ray PhotoEmission Spectroscopy (XPS), Low Energy Electron Diffraction (LEED) and Reflection High Energy Electron Diffraction (RHEED). The listed techniques are inbuilt in a Ultra High Vacuum (UHV) chambers. The SARPES tool is mainly used for studying the electronic band structure/properties of monocrystals. This technique is combined with the RHEED and LEED technique which are used to check the homogeneity of the monocrystals. The XPS tool is a standard technique to probe the chemical species of a given material and understanding the nature of the chemical boundings

MBE laboratory - deposition technique: Molecular Beam Epitaxy chamber combined with RHEED. Chamber dedicated to the evaporation of thin film of Bi, InBi, and Te based Transition Metal Dichalcogenides (TMDCs) materials. The RHEED can monitor if the growth of the thin films occurred layer by layer.

SEM and TEM microscopic techniques: Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). Both methods consist in a beam of electrons directed onto the sample. For the SEM, the subsequent light or electron beam arising from the sample is then analysed which can give a close image of the sample surface and the chemical composition. The TEM consists in analysing the signal going through the sample, giving a very accurate image of the sample.

X-Ray Diffractometers laboratory (XRD): X-rays are shined onto samples at various angles and the subsequent diffraction pattern is collected. XRD is a very powerful tool for determining the nature of the crystals: their molecular structure and their surface orientations.

IR Laboratory for the analyses of photo-thermal properties of materials with equipment measuring photo-thermal properties such as transmittance, reflectance, emissivity, absorptivity, or thermal conductivity. The output is the distribution of these properties as a function of temperature, angle, and wavelength, particularly in the infrared region of the spectrum.

µCT laboratory: Xradia MicroXCT 400 machine, which is a specialized CT device for scanning of low absorbing materials with high resolution. It utilizes low voltage X-ray source (20–90 kV) and interchangeable high resolution detectors. Depending on the sample size, the resolution can vary from 25 to 0.6 µm/pixel. Post Processing of the scanned images (segmentation, resizing, conversion to model data, etc.) can be done in Avizo Software.

Fuel Cell laboratory: storage and conversion of energy from renewable sources, wastes and biomass. we are developing novel fuel cells: direct dimethyl ether fuel cells and direct ammonia fuel cells; next-generation porous nanocatalyst, solid membranes, three-dimensional catalyst.

Biomaterials laboratory: synthesize and characterize bioactive/antibacterial nanoparticles, hierarchically porous inorganic scaffolds and mesoporous antibacterial hydrogels for biomaterials.

Office space: For its activities, the Centre have been using 4 buildings with a total floor area of 2550 m². The administrative staff and management uses approx.100 m², laboratories use 1450 m² and offices 1000 m².

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

- **SARPES instrument** – photoelectron emission spectrometer with spin and angular resolution, electron analyzer PHOIBOS 150, photoemission - XPS, SPIN - angularly resolved photoemission, VUV lamp for SARPES, Vacuum tank
- **Deposition device – MBE System** - for the preparation of monocrystalline thin films using the Molecular Beam Epitaxy (MBE) method
- **X-ray diffraction** – Panalytical X'Pert, Bruker AXS D8 Discover automatic diffractometer
- **Thin film deposition** – BOC Edwards TF600 deposition system, SAMCO PD220N PE-CVD system, Elektrorava PE-CVD multi-chamber deposition system
- **Electron Microscopy** - Transmission Electron Microscopy - TEM JEOL JEM-2200FS, Scanning Electron Microscopy – EOL JSM-7600F, FEI Quanta 200
- **Nanoindentation and tribology** – Bruker Hysitron TI Premier® Dynamic Nanomechanical Test System
- **Hall-effect measuring devices** – ezHEMS - Nanomagnetics Instruments - accessories for measuring at low and high temperatures
- **Chemical composition analyser** – WDXRF - RIGAKU - Supermini200
- **IR diagnostic and equipment** – measuring systems (cameras, detectors, spectrometers), radiation sources (lasers, lamp, emitters),
- **Methods for the analysis of material properties: SNEHT** - Direct optical method for spectral emissivity measurement as a function of temperature, **EDEHT** - Method for effective directional emissivity measurement as a function of temperature, **SNHRRT** - Method for spectral normal hemispherical reflectance measurement (spectral normal absorptivity / emissivity) in visible and infrared spectral range at room temperature, **SNHTRT** - Method for spectral normal hemispherical transmittance measurement in visible and infrared spectral range at room temperature
- **SAXS/WAXS**: Low-angle X-ray scattering, Molecular metrology
- **Computing cluster** – 3,200 core CPU with adequate RAM and over 380 TB of disk array
- **Computer microtomograph (X-ray)** – Zeiss Xradia X-400 Micro-CT
- **Optical spectroscopy** – Atomic spectroscopy - UV / Vis spectrophotometer Specord 210 BU, Spectroscopic ellipsometer SENTECH SE850
- **Vibrational spectroscopy** – FTIR Spectrometer NICOLET 380, DXR Raman spectrometer
- **Materials Printer** – Fujifilm Dimatix DMP-2850
- **Mechanical equipment** – LectroPol 5: equipment for electropolishing and etching
- **High-temperature vacuum furnace** – Carbolite-Gero CTF 12/65/550
- **Precision diamond band saw** - EXAKT 300 CP with accessories
- UF30plus dryer

- Hei-Connect magnetic stirrer
- Rheometer: ARES-G2
- DMA with moisture cell
- Particle size and distribution analyzer: SLS, DLS
- SEA inverse chromatograph
- Water vapor sorption DVS

10. List of the additional benefits (other than listed in the conditions for hosting a DC, see invitation) that the Institution declares to provide for a Dioscuri Centre (i.e.: additional funds, personal benefits, dual career options, relocation support or other):

COOPERATION FOREIGN UNIVERSITIES AND INSTITUTIONS:

All cooperation can be declared by joint publications or by concluding a Cooperation Agreement or a Partnership Agreement.

- **Associate Professor Keisuke Hatada PhD.**, Department of Physics
University of Toyama, Graduate School of Science and Engineering for Research, Japan
- **Assistant Professor Dr. Sanjay Singh**, School of Materials Science and Technology
Indian Institute of Technology (Banaras Hindu University), Varanasi, India
- **Associate Professor Jorge Alcala, PhD.**, Department of Materials Science and Metallurgy
Universitat Politècnica de Catalunya (UPC), Barcelona, Spain
- **Professor Bongjin Simon Mun**, Department of Physics and Photon Science
Department of Physics and Photon Science, Gwangju, South Korea
- **Professor Karol Hricovini, professor Christine Richter**, Department of Physics
Université de Cergy-Pontoise, Faculty of Sciences and Technology, Cergy-Paris, France
- **NTC cooperates with synchrotron centers** (e.g.: PSI Villingen, Switzerland; Advanced Light Source (ALS), Berkeley, USA).
- **In the last 5 years**, we have invited **more than 35 researchers** from abroad from the Academic Career Mobility Program for the Pilsen Region and from the CEDAMNF project.

CONTRACT RESEARCH

NTC cooperates very extensively with industrial companies and provide research and service activities for them by contract research. Volume of contract research is around 13% of total budget resources.

INTERNATIONAL CONFERENCES, SEMINARS ORGANIZED/CO-ORGANIZED:

2019, International Symposium on Future Mobility Safety Science and Technology
 2018, 2019, 2021 – International conference on Applied Physics of Condensed Matter
 2021, Les Houches – WE Heraeus, École de physique des Houches, France
 2021, SPR-KKR hands-on course on magnetism and spectroscopy, Daresbury, UK

DUAL CAREER OPTIONS

prof. Alex Schechter, Ph.D., The Department of Chemical Sciences, Ariel University

Complementary documents for the Evaluation NTC according to the M17 + methodology.

Important research projects, applied research projects, contract research, important results from our research activities, important research persons from the NTC are described here.

https://www.ntc.zcu.cz/en/Research/Evaluation_M17_plus.html

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

INTERNATIONALIZATION

The New Technologies – Research Center (NTC) is focused on strengthening international cooperation and is increasingly involving foreign experts in its research teams. In 2021, the NTC employed 18 foreign researchers from 10 different countries around the world (from a total of 102 full-time employees including management). We plan to increase the number of foreign researchers.

The NTC supports English as the working language. All documents (Rector’s Directive, Director’s Directive, Other Regulations, Annual Reports, Support documents etc.) at the NTC are written bilingually, i.e. Czech and English languages. Most seminars, working meeting and discussion, due to the involvement of foreign workers, are held in English languages.

https://www.ntc.zcu.cz/en/About_us/Important_documents.html

OTHER KEY ACTIVITIES FOR THE INTERNATIONALIZATION

In 2017, the New Technologies Research Center subscribed to the principles of **the European Charter for Researchers** and **the Code of Conduct for the Recruitment of Researchers**.

<https://www.zcu.cz/en/University/Career/hr-award.html>

HR EXCELLENCE IN RESEARCH

New Technologies - Research Centre in December 2018 obtained the so-called HR AWARD certification, which the European Commission awards to research institutions that implement the HRS4R (The Human Resources Strategy for Researchers) strategy based on the principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers.

These principles generally apply to all NTC employees. Activities associated with obtaining and maintaining this award are supported within the university-wide HR Award project, registration number: CZ.02.2.69/0.0/0.0/16_028/0006188.

https://www.ntc.zcu.cz/en/About_us/HR_AWARD.html

NTC GENDER EQUALITY PLAN (GEP)

NTC GEP includes actions to reach objectives following the guidelines of the European Institute for Gender Equality (EIGE) which aims to identify and implement innovative strategies to promote cultural change and equal opportunities in Universities and Research Centres.

https://www.ntc.zcu.cz/en/About_us/Gender_Equality

DOCTOR HONORIS CAUSA PROFESOR KAROL HRICOVINI

During the Ceremonial meeting of the Scientific Board of the University of West Bohemia, the honorary title of doctor honoris causa was awarded to Professor Karol Hricovini.

Prof. Karol Hricovini is a Physicist who works at the French University of Cergy-Pontoise. The successful researcher, who was involved in the creation of a new experimental laboratory SARPES.