

CXI TUL



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The Institute for Nanomaterials, Advanced Technologies and Innovations (CXI) is a research center of the Technical University of Liberec (TUL). Our goal is to contribute to the development of a region traditionally oriented towards technical industries.



A total of **11** departments focus on solving questions not only in the macro world but also in a world a million times smaller than a millimetre, in which different physical rules apply. The one called the nanoworld.



Every year, around **80** research projects employ more than **170** scientific, technical and administrative staff. Students also cooperate on research projects here.



RESEARCH DIRECTIONS



Nanomaterials in natural sciences focus on the R&D, synthesis, behavioral description, and particularly application of advanced materials and nanomaterials, mostly in the field of water treatment, environmental protection and life sciences. This research direction ensures that the innovations contribute to a sustainable and healthier world.



Competitive engineering focuses on the research, development, and application of cutting-edge engineering technologies and structures. We specialize in mechatronic systems, power units, and other machine and vehicle components in view of new approaches. We also excel in progressive methods for processing new materials, including additive technologies. Our innovative solutions are designed to drive progress and efficiency across various industries.



System integration deals with the development of state-of-the-art SW solutions, data processing and integration between systems, cybersecurity and architecture, communication protocols such as 5G, providing communication interfaces for industrial applications. Our expertise covers sensors and electronics, PLCs, robotics, including the use of collaborative robots, cloud application development, big data analytics, machine learning and AI, LLMs, industrial computer vision and others.



RESEARCH DIRECTIONS - COMPETENCES



Autonomous systems

autonomous and cooperative systems
autonomous utility electrovehicle

Additive manufacturing

3D printing including metallic prints and reinforcing by advanced materials

Green technologies, up-scaling

environmental friendly products,
piloting of technologies

Environmental protection

(waste) water and groundwater
treatment, waste disposal, air
filtration

Risk of nanomaterials, high-tech analysis

environmental risk of nanomaterials,
advanced analytical techniques

Advanced materials and machines design

the new light-weight and sustainable components,
innovative design and systematic planning of
technical systems innovations

Augmented reality

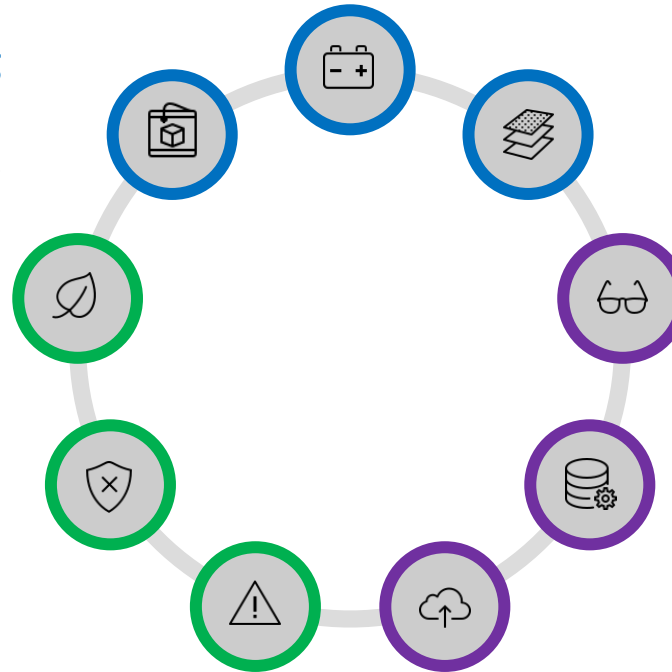
collaboration & remote assistance, mixed
reality wearables

BIG DATA, artificial intelligence

big data storage and analysis, machine
learning & AI, image and pattern recognition

Industrial IoT

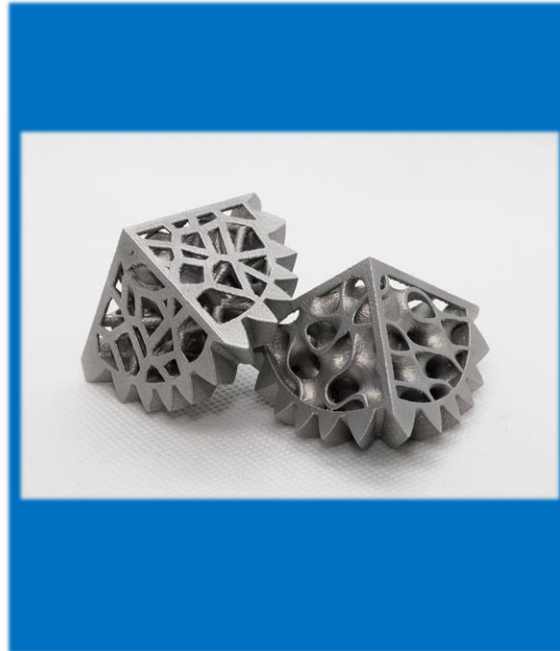
advanced sensors, displays, edge and cloud
computing, 5G and SigFox networks



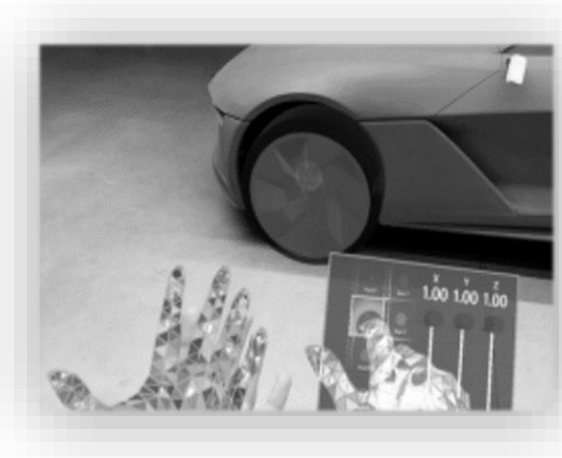
CXI RESEARCH DIRECTIONS



**Nanomaterials in
natural sciences**



**Competitive
engineering**



System integration



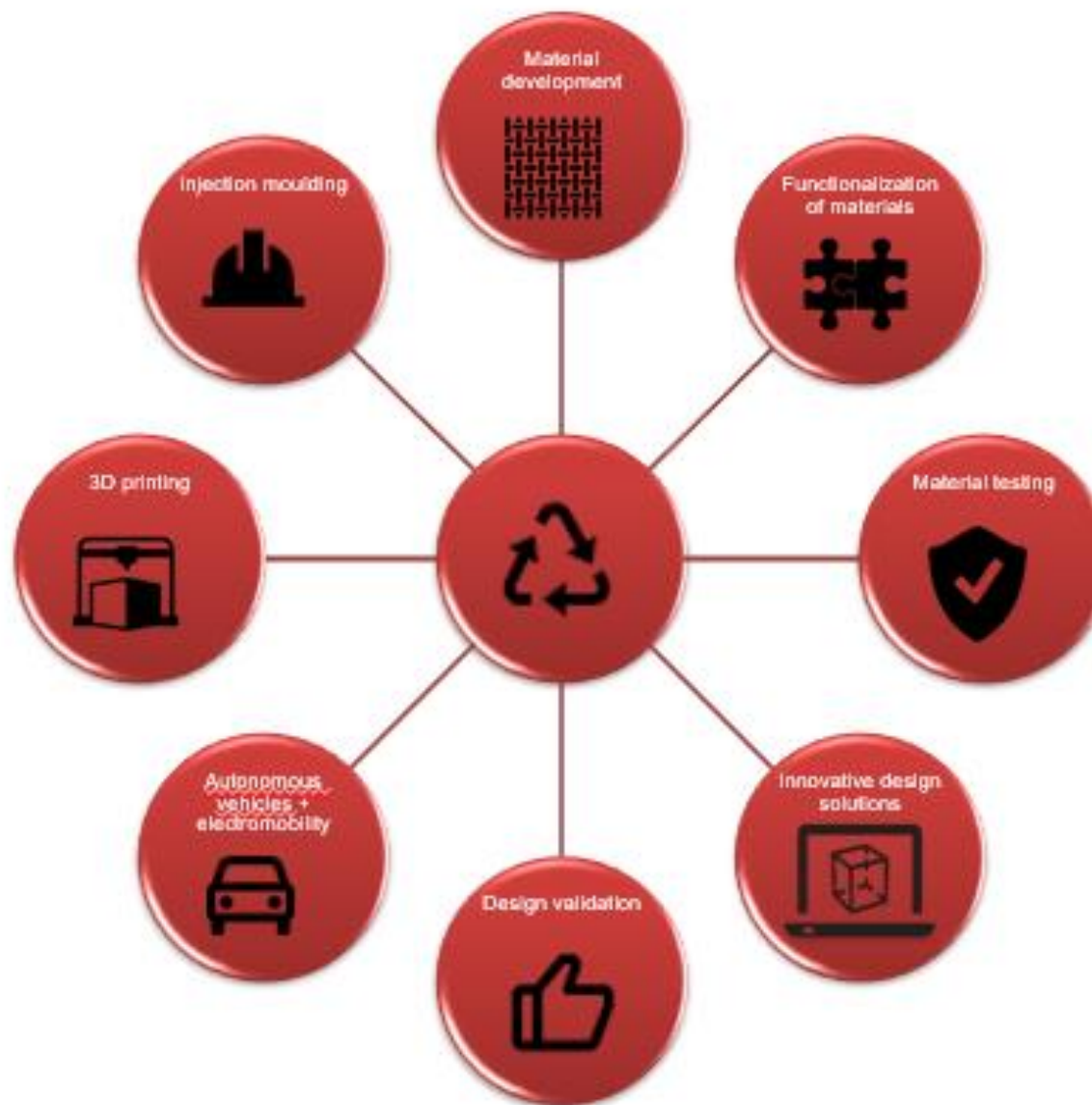
RESEARCH DIRECTION NO. 2



Ing. Jiří Šafka, Ph.D.
Head of RD2



**Competitive
engineering**



COMPETITIVE ENGINEERING



DEPARTMENT OF
3D TECHNOLOGIES



DEPARTMENT
OF VEHICLES



DEPARTMENT OF
MACHINES DESIGN



DEPARTMENT OF
ADVANCED TECHNOLOGIES



DEPARTMENT OF
ADVANCED MATERIALS

The research direction of **competitive engineering** combines research and development in the areas of manufacturing and the automotive industry with great application potential. The workplaces support the industrial activities of companies not just in the close-by regions and focus on the application of new technologies and technological procedures to ensure a higher degree of innovation in industrial production.



DEPARTMENT OF 3D TECHNOLOGIES

MAIN RESEARCH ACTIVITIES

- Advanced research in specialized additive technologies
- Comprehensive activities include not only 3D printing using the most appropriate technology concerning the material to be processed and the targeted product properties but also data preparation, optimization of product geometries or their elements (topological optimization), post-processing operations and the development of new sustainable materials for additive technologies
- Investigating different technological approaches to accuracy, and quality of output parts to increase application possibilities and usability of 3D printed products

COOPERATION

- Research and development of 3D printing technologies
- Design of application-specific 3D printing components and topological optimization
- New 3D printing applications in plastics and metals
- Development of new sustainable materials for 3D printing technologies



Ing. Filip Vele
Head of O3D



DEPARTMENT OF VEHICLES



Ing. Josef Broušek, Ph.D.
Head of OVZ

MAIN RESEARCH ACTIVITIES

- Development and testing of propulsion systems and engines
- Research and development in the field of electromobility
- Research of economic-emission properties of petrol and diesel internal combustion engines for liquid, gaseous fuels and their mixtures
- Power transmission systems in classical and hybrid engine arrangements

COOPERATION

- New hybrid drive systems
- Modifications of mobile and stationary devices meeting future EU 6 emission limits and greenhouse gas limits with emphasis on the use of new types of fuels from renewable sources



DEPARTMENT OF MACHINES DESIGN



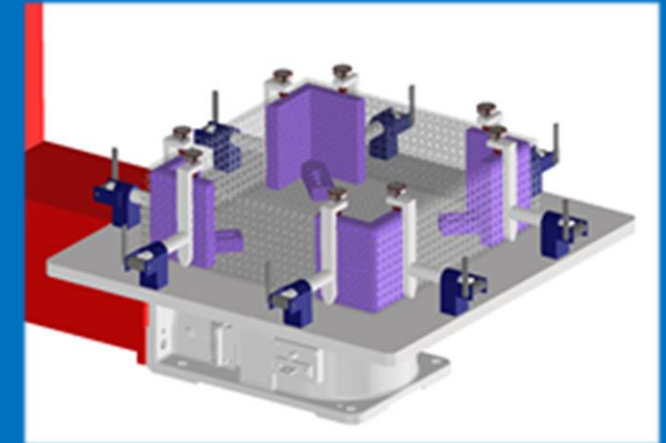
doc. Dr. Ing. Ivan Mašín
Head of OKS

MAIN RESEARCH ACTIVITIES

- Human safety and comfort in vehicles (land, air, water)
- Testing of new concepts and constructions of parts of mobile means of transport
- Mechatronic systems with active regulation

COOPERATION

- Custom machine design
- Measurement of physical properties of active and passive vibration-insulating materials
- Implementation of advanced technologies for product and equipment development using new procedures and methods



DEPARTMENT OF ADVANCED TECHNOLOGIES



Ing. Jiří Bobek, Ph.D.
Head of OPT

MAIN RESEARCH ACTIVITIES

- Development, research, innovation and application of progressive non-chip technologies for processing plastics, composites, metals and non-ferrous metals (casting, welding, forming and processing of plastics and composites)
- Parametrization of technological processes, optimization of processes with regard to efficiency, economy and the environment

COOPERATION

- Measurement of technological parameters during machining with defined and undefined cutting edge geometry
- Highly specialized measurements with unique devices
- Research, innovation and application of progressive technologies



DEPARTMENT OF ADVANCED MATERIALS



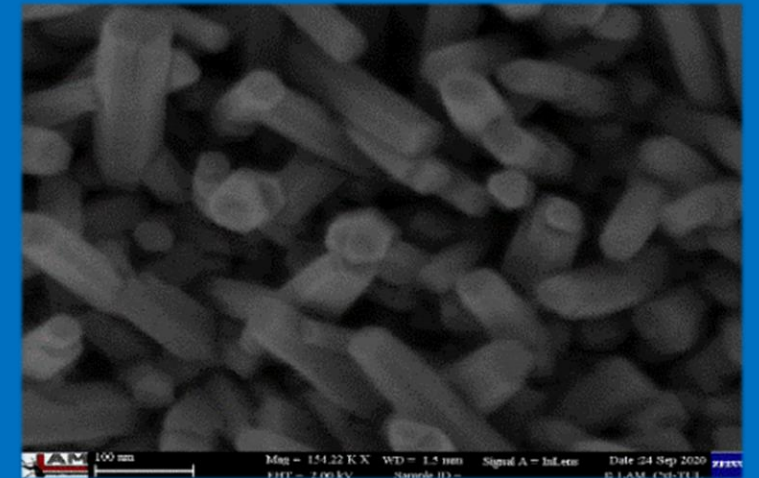
Ing. Mateusz Fijalkowski, Ph.D.
Head of OPM

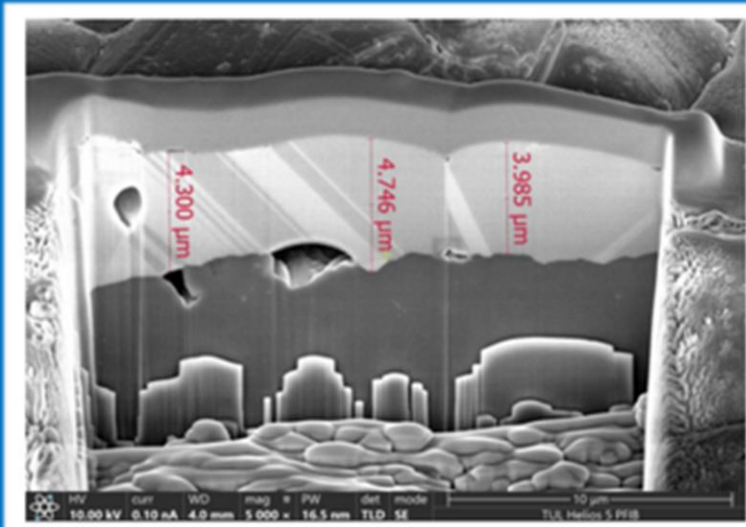
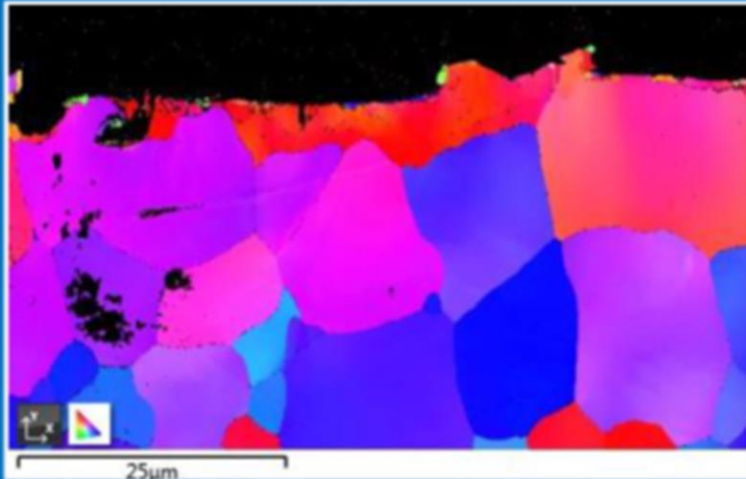
MAIN RESEARCH ACTIVITIES

- Optimized unconventional structures of materials with a high degree of functionality, study of these materials and search for new areas of application
- Elaboration of methodology for measuring properties of thin films and coatings
- Machining technology, creating new types of layers and coatings suitable for specific applications

COOPERATION

- Comprehensive analyzes of materials, including microanalysis
- Material research focused on the development of linear and three-dimensional nanofiber structures, study of nanoparticles
- Professional support in solving production and technological issues in the industrial sphere





Laboratory of Microscopy (LMI)

M. Fijalkowski

- Analyses of input and output materials of advanced technologies, in particular materials with thin films, nanoparticles or nanofibers
- Materials research focused on the development of linear and three-dimensional nanofibrous formations, the study of new materials containing nanoparticles, composite materials and others
- Application of analysis results in materials research



PROJECT SOLUTIONS (E.G.)



JOSEF BOŽEK COMPETENCE CENTRE FOR THE AUTOMOTIVE INDUSTRY

Ing. Robert Voženílek, Ph.D.

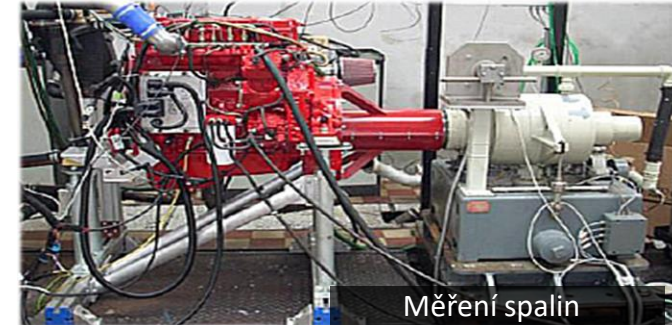
e-mail: robert.vozenilek@tul.cz
tel.: +420 485 353 376

Goals:

- reducing the consumption of fossil fuels,
- reduction of CO₂ emissions,
- increase safety and comfort.

The Center develops future means of sustainable mobility of road and rail vehicles and further develops the technical levels of fields important for the economy of the Czech Republic.

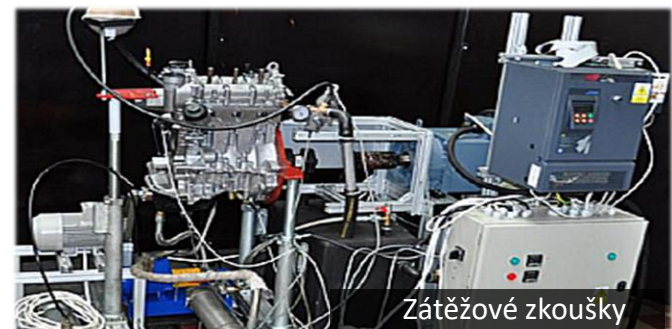
Connects **4 universities**: TUL, ČVUT, VUT Brno, VŠB,
and **9 industrial partners**: Škoda Auto a.s., TÜV SÜD Czech s.r.o., Ricardo Prague s.r.o., MOTORPAL a.s., Honeywell, spol. s r.o., BRANO a.s., ČZ a.s., AICTA Design Work, s.r.o. and TATRA, a.s.



Měření spalin



Válcová brzda



Zátěžové zkoušky





P3DT

Ing. Jiří Šafka, Ph.D.

e-mail: jiri.safka@tul.cz
tel.: +420 485 353 801

P3DT



CENTRUM
PRO PRŮMYSLOVÝ
3D TISK



NCK TAČR – Centre for Industrial 3D Printing

The main objective is to **increase the potential of additive technologies** through the efficient and environmentally friendly use of raw materials or energy, the development of materials with specific properties and the creation of new products, the design of appropriate technologies and the use of digitalization, enabling a high degree of optimization.

The objective will be achieved by implementing sub-projects involving at least 26 partners, resulting in at least 80 applied research results with high implementation potential.

A secondary objective is **creating a platform** exploiting the multiplier effect of interdisciplinary networking of research organisations and industrial leaders with shared know-how, which will facilitate the long-term and sustainable development of additive technologies in the Czech Republic and thus increase its competitiveness.





MATCA

Ing. Michal Ackermann, Ph.D.

e-mail: michal.ackermann@tul.cz
tel.: +420 485 353 723

TUL expert in the field of metal 3D printing and topological optimization, industrial design

Ing. Jan Kočí

e-mail: jan.koci@tul.cz
tel.: +420 485 353 606

Digitalisation, management, enterprise and software architecture, integration



NCK TAČR - National Centre of Competence for Materials, Advanced Technologies, Coatings and their Applications II

The centre mainly develops additive, plasma, and laser technologies. Given their impact on industry, economy and security, mastering and developing these technologies is strategically essential. We are developing 3D printing, plasma, lasers, surface treatment, simulation, analysis, and digitalization.

Within the framework of long-term R&D projects, NCK MATCA covers the entire product life cycle smart design through environmentally friendly production, repair, and restoration of functional properties to dispose of hazardous waste.





Interreg



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der Europäischen Union
Spolufinancováno
Evropskou unií

Sachsen - Tschechien | Česko - Sasko

SUPPORT4SME Grenzüberschreitende Unterstützung für die Beteiligung von KMU an der zukünftigen Materialforschung SUPPORT4SME Přeshraniční podpora zapojení malých a středních podniků do materiálového výzkumu budoucnosti

Hauptziel des Projektes

Hlavní cíl projektu

Entwicklung und Bearbeitung gemeinsamer Forschungsthemen und Bereitstellung von wissenschaftlichen Dienstleistungen.
Rozvoj a řešení společných výzkumných témat a poskytování služeb aplikovaného výzkumu.

Leadpartner: Technische Universität in Liberec
Technická univerzita v Liberci



Projektpartner: Technische Universität Chemnitz
Technická univerzita Chemnitz



Gesamtkosten des Projektes
Celkové náklady projektu

3.052.522,28 Euro



Mehr Informationen über das Programm finden Sie auf unserer Website!
Více informací o programu najdete na našich webových stránkách!



www.sn-cz2027.eu





ELECTROMOBILITY

doc. Ing. Michal Petrů, Ph.D.

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OP VVV - Modular platform for autonomous chassis of specialized electric vehicles for freight and equipment transportation

The aim of the project is the development and experimental verification of a competitive autonomous battery vehicle for the transport of medium and higher weight loads in general terrain.

Solutions to the following scientific research problems represent partial goals of the project:

- modular architecture of the chassis using so-called light constructions,
- drives and accumulators for autonomous commercial electric vehicles,
- research in the field of autonomous commercial electric vehicle control systems using shared reality or the Internet of Things to interact with other entities.

Potential users are logistics operations in the general terrain (construction, mining, agriculture, industrial enterprises, special forces).





Interreg



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Spolufinancováno
Evropskou unií



Sachsen – Tschechien | Česko – Sasko

Projekttitel:

Interdisziplinäre Brücke – InterBridge

Název projektu:

Interdisciplinární most – InterBridge

Hauptziel des Projektes

Hlavní cíl projektu

Die Region Liberec und Sachsen verfügen über ein reiches kulturelles und wissenschaftliches Erbe sowie über begabte Künstler und Wissenschaftler. Deshalb wurde dieses Projekt ins Leben gerufen, um dieses Potenzial zu nutzen und die Zusammenarbeit zwischen Wissenschaft und Kunst auf grenzüberschreitender Ebene zu entwickeln. Das Hauptziel von Interbridge besteht darin, Wissenschaft und Kunst vor allem durch Bildung, neue Technologien und Materialforschung zu verbinden.

Liberecký kraj a Sasko mají bohaté kulturní a vědecké dědictví i talentované umělce a vědce. Proto vznikl projekt, který by umožnil využití tohoto potenciálu a rozvoj spolupráce mezi vědou a uměním na přeshraniční úrovni. Interbridge má jako hlavní cíl propojení vědy a umění především prostřednictvím vzdělávání, nových technologií a materiálového výzkumu.

Leadpartner: Technische Universität in Liberec
Technická univerzita v Liberci

Projektpartner: Technische Universität Chemnitz
Technická univerzita v Chemnitz

Gesamtkosten des Projektes

Celkové náklady projektu

1.190.487,12 Euro



Mehr Informationen über das Programm finden Sie auf unserer Website!
Více informací o programu najdete na našich webových stránkách!





Foto: Zuzana Bajtová (Fotobanka TUL)

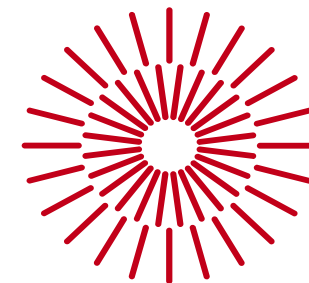


We look forward
to you!

CXI TUL



INSTITUTE FOR NANOMATERIALS,
ADVANCED TECHNOLOGIES
AND INNOVATION TUL



RESEARCH ON THE TOP

