**Research activity lines of investigation by ACCORD laboratories**

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| **BIOTECH/BIOMED** | |
| **Laboratory** | **Research activity** |
| Preparatory laboratory for biotech & biomed at UK | Preparation, processing, storage of samples for other ACCORD laboratories. |
| Improvement of manipulation, processing and preparation of samples with the aim to enhance the higher security and exclusion of possible contamination; optimisation of preparatory research activities. |
| Lab of microscopic methods at UK | Highly-detailed sample observation and recording for all applications in cell biology, neuroscience, molecular genetics, zoology and microbiology |
| Performance of highly complex imaging experiments |
| Lab of optical methods and bioimaging | Rapid quantitative analyses of increasing number of diverse microvolume samples (DNA, RNA, proteins) in a wide range of biological experiments in the biomedical research and biotechnology |
| Lab of physiological and behavioural fenotypisation | Research of new biologically active compounds through simultaneous evaluation of selected behavioural and physiological variables |
| Research of neural control of cardiovascular system through simultaneous evaluation of selected behavioural and physiological variables |
| Evaluation of energy metabolism at a system level through simultaneous evaluation of selected behavioural and physiological variables |
| Lab of molecular genetics and gene expression | Investigation of mycobacterial cell wall biosynthesis that opens a site for the development of new tuberculosis drugs, |
| Investigation of the replication and maintenance of telomere which play a key role in complex biological processes such as cell senescence, lung cancer as well as carcinogenesis; |
| Investigation of the biology of unconventional yeasts, which are promising organisms for modern biotechnology. |
| Lab with BL3 security level at UK | Research to monitor the incorporation of radioactive precursors of macromolecules into pathogenic microorganisms affected by potential inhibitors |
| Lab of bioorganic chemistry at UK | Development of new, more efficient, faster, cheaper and more environmentally friendly syntheses of drugs and pharmaceutical intermediates |
| Lab for organic materials for electronics and sensors | Preparation and characterization of new organic compounds |
| Research in personalized medicine in the form of new non-invasive diagnostic methods for the early and rapid diagnosis of selected human disorders and diseases based on the characterization of new biomarkers and the development of new chemotherapy and bio-sensors. |
| Palynology lab at UK | Quantification of allergenic molecules of pollen grains and spores in the atmosphere, impossible with standard aeropalynological equipment, |
| Analysis of bioparticles spread in the atmosphere and identification of the ratio of local bioparticles and those transported through a long distance, |
| Spatiotemporal prognosis of allergenic potential of the atmosphere, and analysis of the spread of invasive plant species to new areas. |
| Radioisotope lab at UK | Analytical and preparative separation, analysis and detection of radiolabelled metabolites allowing very sensitive detection and precise quantification of various types of biomolecules, serving a wid variety of researchers. |
| Laboratory for fermentation technologies and applied biocatalysis/STU | Fermentative production of organic acids, biotransformation of carbohydrates, immobilization of biocatalysts, biocatalysis process intensification and recombinant biocatalysis |
| Biocatalyst production by expression in E.coli and P.pastoris |
| Transfer of biocatalysis processes to pilot plants |
| Development of novel biocatalysts, application of cutting edge technologies (such as combined chemo-bio catalysis), and/or application of biocatalysts in non conventional media or to non natural substrates |
| Laboratory for analysis of the protein structures and functions/STU | Isolation and structural/functional characterization of important proteins from microbial and animal cells. |
| Characterization of altered protein structure/functions in human/animal cells induced by progression of civilization diseases pathology like neoplastic malignant transformation and progression. |
| Characterization of altered cell homeostasis involved with neoplastic transformation, and particularly after development of multidrug resistance. |
| Studying the structural alterations induced by altered protein structure/function in cells under civilization diseases pathology. |
| **ADVANCED MATERIALS** | |
| **Laboratory** | **Research activity** |
| Laboratory for PPMS measuring | Research into new possibilities in measuring nanostructures such as heat capacity measurement, AC susceptibility, measurements of charge carriers concentration |
| Measurement of quantum phenomena in nanostructures |
| Measurement at high magnetic fields up to 14 T |
| Ion Analyser Laboratory | Development of advanced methods of material analysis using accelerator mass spectrometry and ion beam analysis (PIXE, PIGE, RBS, etc.), including surface mapping of elements using nuclear microscope and radionuclide distribution patterns in technical, biomedical and environmental samples. |
| Laboratory for organic electronics/STU | Fabrication and characterization of electronic devices and systems prepared from various organic materials |
| Sensing properties and sensor applications of organic materials suitable for organic field-effect transistors, organic light-emitting diodes (OLEDs), as well as solar cells. |
| Investigation of organic conductive materials |
| Nanoparticle (NP) research - dielectric, semiconducting, or metal NPs: NP surface modification, NP depositions, and layer characterization. |
| Laboratory for material research at the Institute of Electrical Engineering/STU | Development and testing of new progressive ceramic and composite material structures for use in electrical engineering, electronics and biomedical applications |
| Development of new testing and measurement techniques for practical applications, using the latest trends in static, low frequency and high frequency measurements as well as non-destructive defectoscopy |
| Laboratory of particular matters/STU | Research of basic mechanical and physical properties of advanced particulate materials /organic and inorganic/ and three-phase system with the particulate solid phase, |
| Research and verify the compressibility and heat effects of the powder material under extreme compression, |
| Research, design and validation of agglomeration and granulation technologies aimed primarily to transforming the different shape of dry and wet materials with fine-grained solid phase, |
| Research, design and validation of unconventional composites, |
| Design and manufacture of pilot experimental and production equipment |
| STU Centre for nano-diagnostics/STU | Investigation of InAl(Ga)N thin layers for HEMT transistors with 2D hole gas |
| Novel BaSi layers for photovoltaic applications |
| TaAlN, AlTiSiN, AlCrN, AlCrSiN, ZrN, ZrAlSiN superhard coatings for cutting tools |
| Electronic transport properties of diamond/graphene interfaces and their interaction |
| Investigation of transition metal dichalcogenides for biomedical applications |
| Characterization of morphology, size, faceting and chemical composition of nanoparticles/ nanotubes/nanowires/nanorods |
| Laboratory for microscopic, spectral and thermic techniques/STU | Knowledge and relationships between the composition, structure, spectral and magnetic properties, and bio-activity of copper(II) complexes containing bio-ligands |
| Magnetic behaviours of manganese(II), iron(II), iron(III), cobalt(II), nickel(II), and copper(II) complexes (magnetic anisotropy, spin crossover, molecular magnetism, nano magnetism) |
| Chemistry and electrochemistry of molten salts, surface treatment of metals |
| Development of new types of bio ceramics based on hydroxyapatite and its composites, bioactive materials and bio composites ceramics-biopolymers, evaluation of bioactivity |
| Ceramic and cement foams, materials with high oxidative strength, nanocomposite materials for 3D printing |
| Laboratory for environmental impacts of motor vehicles/STU | New materials research for their damping and energy absorption properties with respect to fast dynamical processes (crash and impact testing) |
| Structural properties for interior material (car safety, driver ride comfort) |
| Acoustic emission absorption of material for their use in automotive industry (vehicles/cars interiors) |
| Alternative gases as a fuel and their impact to operating state and harmful emissions of gases and acoustic emission (NVH) |
| New materials (plastics, environmentally friendly recyclable) and their operating lifespan |
| Laboratory of arrayed molecule layers and nanostructures for organic electronics/STU | Research of physical properties covering the structure of two-dimensional molecular systems (X-ray diffraction, rtg. reflection, STM, AFM, SEM) as well as electrical transport of charge carriers in organic layers and at interfaces, the switching effect at the molecular level, and the study of processes of self-organization in molecular systems with several components |
| Laboratory for thermochemical heat accumulation/STU | Experimental research of new promising thermal storage methods especially from the field of thermochemical heat accumulation, eutectic materials and phase change materials |
| Research into methods of efficient cold accumulation |
| Biomechanics labs/STU | Study of mechanical properties changes in human tissues for civilization diseases, for example diabetes mellitus, cardio logical problems, etc. |
| Determination of mechanical properties of soft tissue replacements, for example blood vessels, pancreas and other soft tissues |
| Determination of mechanical properties of composite materials applicable as biocompatible implants |
| Laboratory of environmental technology/STU | Studying the effects of the energetic fields on temperatures and the kinetics of phase transformations of the advanced materials |
| Research of effects of the energetic fields on the structure, mechanical and other specific properties of the metal and other advanced material |
| Shaping of the molten metal surface using the electromagnetic force |
| **ICT** | |
| Laboratory | Research activity |
| ICT Laboratory/UK | Analysis of signals sent over the communication bus, capturing, analysing and generating radio communications in real time |
| Validation of security of different software and hardware virtualization techniques |
| Visualization of big data, processing of biometrical data e.g. for authentication purposes |
| HI – TECH Centre EMC/STU | Build the unique (for Slovakia) measuring and testing infrastructure in EMC supporting the development of electrical systems in automotive industry |
| Development of collaborative research in new peripherals in automotive technology, military technology, modern information and communication technologies, power engineering and other areas requiring high EM energy exposures |
| Mechatronic laboratory for digital factories and IoT/STU | Development of new adaptive, robust and nonlinear control methods that respect constraints of any kind, measurement and quantization noises and uncertainties |
| Investigation of systems with varying communication time delays typically occurring in different application of IoT |
| Development and testing of a new type of communication between vehicles (V2V – vehicle to vehicle) and other subjects and objects of transportation (V2E – vehicle to everything) |
| Laboratory of robotics, cybernetics, Industry 4.0/STU | Active subsystems of power systems with focus on alternative energy sources including modern hydroelectric power plants |
| New control methods for alternative energy sources in power systems to increase the ability to provide general stability (and quality) of power system. |
| New HRI methods in industrial robotics applications (collaborative robotics, dynamic gestures, smart bin-picking). |
| Intelligent movement in the environment of mobile robots (SLAM, path planning, reactive navigation). |
| Laboratory for intelligent analysis and big data processing/STU | Exploration of new data analytics methods utilizing AI and ML approach. |
| New approaches in natural language processing focused on Information Extraction in areas as sentiment identification, primarily in Slovak. |
| Analysis and processing of big data coming from cytometry for correct identification of cell hierarchy. |
| New methods for assembling and analysis of DNA data with the focus ambiguities present in data produced by the newest sequencing technologies |
| Development of new data structures for fast search in large sequencing data set |
| Exploration of approaches based on parallel computing and metaheuristics for solving hard optimization problems |
| Laboratory for human – web apps interaction/STU | Research of advanced interaction of humans with applications that reside in the web environment, focusing on web-applications used through mobile devices |
| Research into group eye-tracking enabling large scale interaction data gathering and unlocking the full potential of quantitative data analysis |
| Laboratory for advanced software development/STU | Representing and reusing software knowledge: interrelating and visualizing heterogeneous software knowledge, multidimensional software modeling, agile and lean people organization, software processes, social connotations, software product lines and variability and software patterns |
| Software comprehension and quality: intent comprehensibility, use case driven modularization, advanced/aspect-oriented modularization, software quality, refactoring, automated testing and continuous revisions, software modeling beyond software development, education for software development and supported by software development and visualization of software properties. |
| Laboratory for computer networks security/STU | Wired communication networks: Ethernet technologies, Optical communication, routing and switching |
| Wireless technologies going from WiFi through IoT technologies (e.g. LoRa) to mobile networks |
| Architecture for efficient content delivery - Content Delivery networks - CDN and advanced architectures based on Software De-fined Networking - SDN and IP Multimedia Subsystem – IMS – including virtualization using Network Function Virtualization - NFV. |
| Laboratory of secure applied computer science/STU | Modelling, analysing and prototyping complex inter-connected socio-technical systems that reflect the current environment, where vulnerabilities and threats are a consequence of interactions that were not considered in the design phase |

*Source: STU and UK*