FunGlass

EQUIPMENT CATALOGUE

CENTRE FOR FUNCTIONAL AND SURFACE FUNCTIONALIZED GLASS

FUNGLASS.EU

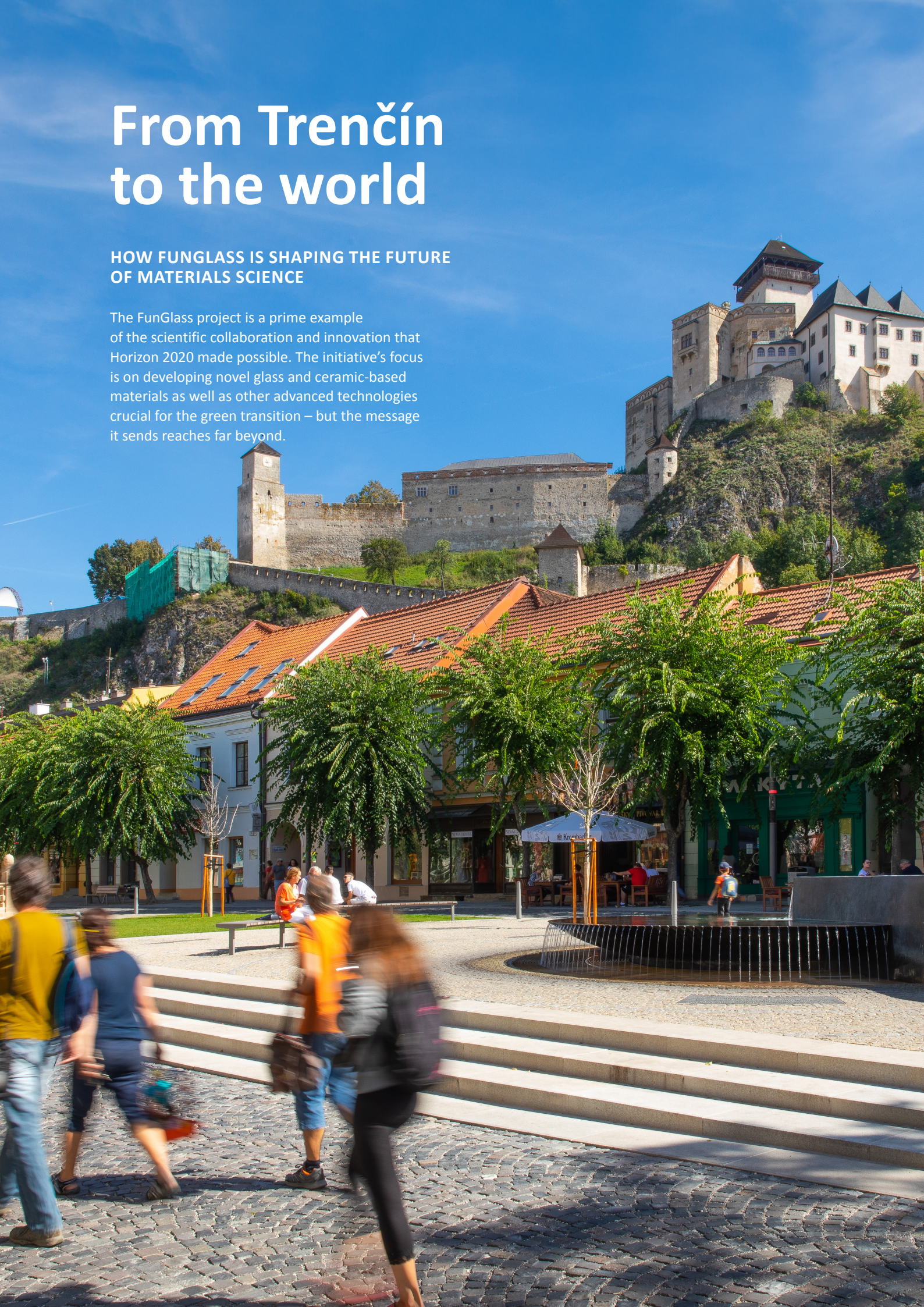
TRENČIANSKA UNIVERZITA

Funded by the European Union

From Trenčín to the world

HOW FUNGLASS IS SHAPING THE FUTURE OF MATERIALS SCIENCE

The FunGlass project is a prime example of the scientific collaboration and innovation that Horizon 2020 made possible. The initiative's focus is on developing novel glass and ceramic-based materials as well as other advanced technologies crucial for the green transition – but the message it sends reaches far beyond.



“Scientific excellence is contagious,” says coordinator Dušan Galusek from the Alexander Dubček University of Trenčín. “With FunGlass, we demonstrate how expertise from top European partners can be transfused into a young, aspiring institute, empowering it to carry out great research.”

Under the mentorship of partners from Germany, Italy and Spain, FunGlass has established four new research departments and recruited more than 100 highly skilled personnel from 20 countries. Their common goal is to push the boundaries of knowledge while designing materials for photocatalysis, hydrogen-powered glass melting, composite implants, antibacterial treatments, waste glass recovery, and corrosion-resistant coatings.

TRANSFORMING FACILITIES AND ADVANCING RESEARCH

Central to the project is bringing established institutions and young emerging institutions together. This approach supports a transfer of excellence, and also contributes to the sustainable development and prosperity of the common European space.

With FunGlass, the Commission has invested a total of EUR 10 million in premises and state-of-the-art research infrastructure in Trenčín, creating the Centre for Functional and Surface Functionalized Glass. These investments have facilitated a dramatic increase in scientific output, with over 50 publications annually, new competitive funding for 30 national and 9 transnational research projects, and several patent applications.

To maintain innovation, the project also focused on education and institutional development. It enabled long-term training stays with prestigious universities across Europe and devised an extensive programme for researchers and students which has already involved 345 people. This includes double-degree PhD collaborations with institutions such as FAU Erlangen-Nürnberg and the University of Jena in Germany, the University of Padua in Italy, the Spanish National Research Council and Brno University of Technology in Czechia.

COLLABORATIVE AND INTERSECTORAL EFFORTS

Cooperation is at the heart of the project’s success, so it’s not surprising that FunGlass has already forged 24 new collaborations with industrial partners and secured numerous contractual research orders.

Recognition of the project’s achievements is evident through various awards and nominations, including the Scientist of the Year award in Slovakia for Galusek in 2020 and the L’Oréal-UNESCO For Women in Science award in 2023.

The FunGlass project illustrates that great science can thrive anywhere with the right support and collaboration.

It highlights the importance of programmes that support the transfer of excellence from established institutions to emerging ones.

By fostering solidarity and cooperation, such initiatives contribute to sustainable development and prosperity across Europe. As Galusek aptly concludes, “Science knows no borders. Supporting programmes like FunGlass not only helps emerging institutions but also enriches the entire European scientific community.”

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European Commission

Dear Prospective FunGlass Partner

As the Director of FunGlass, I have the privilege of leading a talented international team of researchers who operate state-of-the-art facilities in pursuit of a common goal: pushing the boundaries of knowledge.

Our passion lies in researching glass and ceramic materials, with a special focus on their functional properties—luminescence, electrical, magnetic, catalytic, and sorption characteristics. We also explore the functionalization of conventional glass to modify these properties and introduce new functionalities, unlocking innovative applications for glass in society.

While glass and ceramics remain at the heart of our work, as scientists, we are always eager to explore new horizons and apply our expertise in novel settings.

This catalogue showcases our advanced research facilities, built through years of dedication and investment. It highlights the technical capabilities of our infrastructure, but beyond the equipment itself, we have developed extensive operational expertise. To help you navigate these resources, we provide direct contact details for experts who can offer further insights into our capacities. As stewards of this significant public investment, we are committed to making the best use of our resources. That is why we welcome partnerships with those who share our vision of advancing scientific knowledge.

If you find anything of interest, do not hesitate to reach out. Collaboration is the key to progress, and we invite you to become part of the FunGlass Network.

Prof. Dušan Galusek, DrSc.
FunGlass Director

Academics partners

Industrial partners

Industrial partners

Science knows no borders. The EU-funded FunGlass project demonstrates how the expertise of top European partners can breathe new life into a young, aspiring institute. An upgrade of the Centre of Excellence for Ceramics, Glass and Silicate Materials in Trenčín, Slovakia, is delivering not only advanced science, but improved economic and social development in the region.

Content

Biological testing laboratory of materials

Composed of cell culture, cell analysis and microbiology laboratories. It provides basic and advanced methods for testing biomaterials and other materials with expected biological effects. The laboratory is fully equipped to provide basic in vitro biocompatibility testing (bioactivity tests, cytotoxicity/viability assays, haemocompatibility assays, etc.) as well as to determine the potential antimicrobial effect of the materials developed.

- **3D-BIOPLOTTER**
- **MICROPLATE SPECTROPHOTOMETER**
- **FLOW CYTOMETER**
- **BIOLOGICAL SAFETY CABINET**
- **FREEZE DRYER**
- **FLUORESCENT MICROSCOPE**
- **INCUBATORES**

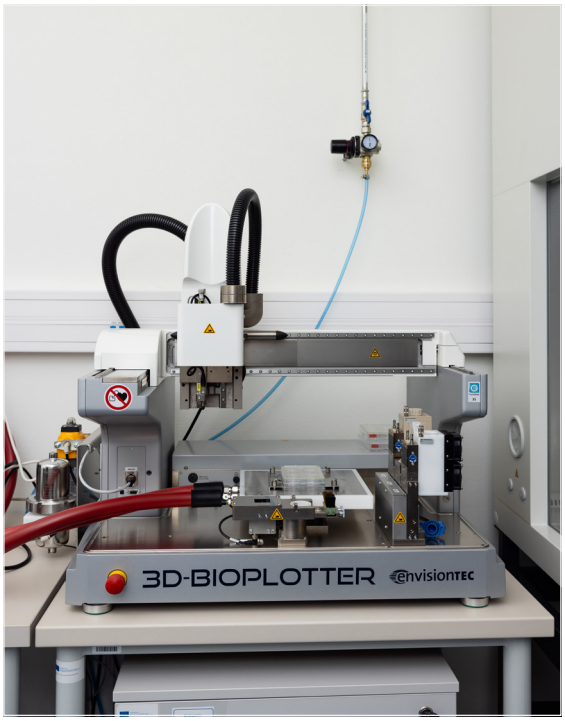
3D-BIOPLOTTER

FUNCTION AND USE:

The 3D-Bioplotter is a rapid prototyping machine especially designed for the fabrication of scaffolds for biomedical applications. Utilize a wide range of materials from soft hydrogels over polymer melts to hard ceramics.

TECHNICAL SPECIFICATION:

- Building platform size: 200 × 220 × 140 mm
- Building platform temperature control: from -10 °C to 80 °C
- Computer-controlled print head movement with a resolution of ≤ 0.001 mm in the x, y and z directions
- Device equipped with print heads for printing at low temperatures – in the temperature range from 0 °C to 70 °C, as well as at high temperatures – in the temperature range from 30 °C to 250 °C



Model:
EnvisionTEC GmbH 3D-Bioplotter®
Developer Series

Responsible person:
Fatih Kurtuldu, fatih.kurtuldu@tnuni.sk

MICROPLATE SPECTROPHOTOMETER

FUNCTION AND USE:

Epoch microplate spectrophotometer has monochromator-based optics, for a filter-free, wide wavelength range for UV-Vis absorbance measurements. These measurements can be done in many microplate formats and in 2 µl samples, when the available microvolume plate is used. Epoch is controlled by Gen6 Data Analysis Software, with simple programming and powerful data analysis.

TECHNICAL SPECIFICATION:

- Wavelengths from 200 to 999 nm for UV-Vis applications enable fast nucleic acid and protein quantification in microplates
- Qualitative and quantitative colorimetric assays
- Microvolume detection for small, 2 µl sample volumes for direct DNA, RNA, and protein quantification
- Get rapid results for up to 48 samples at a time

Model:
Epoch

Responsible person:
Zuzana Neščáková, zuzana.neščáková@tnuni.sk

FLOW CYTOMETER

FUNCTION AND USE:

It is a compact instrument for the analysis of individual cells and microscopic particles in suspension. Benchtop multiparametric flow cytometer with two excitation sources and the ability to detect 4 stains in a single analysis.

TECHNICAL SPECIFICATION:

- Excitation by at least 2 excitation sources: one with 488 nm ±2 nm excitation and one with 640 nm ±2 nm excitation
- 4 detection channels
- Light scattering detectors – FSC and SSC
- Range of measured cell sizes from 0.2 to 60 µm
- The easy-to-use CyFlow software provides control of the instrument, data acquisition, analysis and storage
- Offers True Volumetric Absolute Counting (TVAC), which allows the display of particle concentrations for any subsets of cells without the need for reference beads, even if defined by a gate at a later time after the acquisition

Model:
CyFlow Cube6 N1/Sysmex Europe GmbH

Responsible person:
Zuzana Neščáková, zuzana.nescakova@tnuni.sk

BIOLOGICAL SAFETY CABINET

FUNCTION AND USE:

Class II laminar box for protection of operators, environment and products when working with active and toxic materials, tissue cultures, media preparation and handling of pathogenic material. Allows for easy cleaning and sterilization in an autoclave, equipped with electrical outlets for connecting equipment used in the box and an electrically operated pull-out window. Height-adjustable pedestal under the box allowing ergonomic work while seated, UV lamp to sterilize the environment and safety flame with sensor switching.

TECHNICAL SPECIFICATION:

- Internal volume of at least 110 litres
- Internal sealed transparent door for visual inspection of samples without alteration of the internal environment
- 1 socket in the chamber for the connection of equipment located in the incubator
- Microprocessor-based temperature control with a minimum temperature range of +5 °C to +70 °C with display, adjustment in increments of 0.1 °C
- Forced air circulation

Model:
Thermo Fisher HERAsafe 2030i
Biological Safety Cabinet

Responsible person:
Zuzana Neščáková, zuzana.neščáková@tnuni.sk

FREEZE DRYER

FUNCTION AND USE:

Freeze drying equipment removes water from objects by freezing, low pressure and sublimation. It can be applied for drying of water-containing materials (hydrogels), aqueous solutions/ suspensions.

TECHNICAL SPECIFICATION:

- Cold trap capacity: 2 litres
- Condensing capacity: from 750 cm^2
- Condenser surface: 680 ml
- Defrost heater
- Minimal temperature: max. -60 °C
- Analog vacuum gauge
- Standard temperature: -55 °C
- CFC free cooling system
- Danfoss 1/6 PS Compressor

Model:
Unicryo MC 2 L -60 °C

Responsible person:
Si Chen, si.chen@tnuni.sk

FLUORESCENT MICROSCOPE

FUNCTION AND USE:

Inverted fluorescence optical microscope allowing measurements in transmitted light in brightfield and phase contrast and optionally in reflected light in epi fluorescence.

TECHNICAL SPECIFICATION:

- Equipped with a turret head for 4 lenses, 4 long working distance objectives allowing measurements at magnifications, 4x or 5x – 11 mm, 10x – 8.5 mm, 20x – 4.5 mm, 40x – 2.5 mm
- Binocular tube with eyepieces with a minimum magnification of 10x and a field of view width of 22 mm with a dioptric correction of ±5 diopters
- Equipped with one port for connecting a digital camera with an optical path ratio of at least 100–0/0–100

Model:
Eclipse Ts2R-FL/Nikon

Responsible person:
Zuzana Neščáková, zuzana.neščáková@tnuni.sk

INCUBATORES

CO_2 incubator – Controlled atmosphere cell culture device

FUNCTION AND USE:

A controlled atmosphere device for the cultivation of cell and tissue cultures under defined conditions of temperature, humidity and gas pressure.

TECHNICAL SPECIFICATION:

- CO_2 atmosphere control option – selectable CO_2 content from 0% to 20% with a sensitivity of 0.1%
- Ability to maintain constant humidity up to 95% at 37 °C
- HEPA filter at gas inlet to protect samples from contamination
- Device has temperature control from a minimum of 7 °C above ambient temperature up to 55 °C with a sensitivity of 0.1 °C

Model: Thermo Fisher Heracell Vios 160

Laboratory cooled incubator

FUNCTION AND USE:

A cooled incubator for working with biological material sensitive to external temperature changes can provide a stable temperature between 3 to 70 °C regardless of ambient conditions.

TECHNICAL SPECIFICATION:

- Microprocessor-based temperature control with a minimum temperature range of 3 °C to 70 °C with display, adjustment in increments of 0.1 °C
- Forced air circulation

Model: POL-EKO Cooled incubator ST 2 C Smart

Shaking Incubator

FUNCTION AND USE:

Benchtop shaking incubators offer a comprehensive range of growth requirements for biological organisms, including time, temperature, and orbital or reciprocal agitation.

TECHNICAL SPECIFICATION:

- Adjustable shaking motion from 50 to 580 rpm, adjustable shaking radius from 1 to 40 mm
- Cooling of the inner chamber, temperature adjustable from 5 °C to 60 °C
- Internal chamber volume 69 l
- Timer with range from 1–9 000 min

Model: Labwit ZWYR-200D Series Shaking Incubator

Responsible person:
Zuzana Neščáková, zuzana.nescakova@tnuni.sk

OTHER EQUIPMENT

Automatic cell counting
NanoEnTek EVE

Refrigerated centrifuge
Eppendorf 5804 R

Deep freezer box
CryCube F101h/ Eppendorf

Laboratory autoclave sterilizer
3870 elv d-LINE/TUTTNAUER

Biological Safety Cabinet
ESCO

Laboratory glassware washer
Miele

Clean water production system type II
Merck Millipore Elix Essential 5 UV

Steam Sterilizer
STE-B18-C iCanclave

Sample preparation

The sample preparation laboratories are equipped with advanced tools for precise cutting, grinding, polishing, and coating of materials to ensure optimal sample quality for further analysis. It enables the preparation of specimens for structural, chemical, and mechanical characterization, ensuring reproducibility and accuracy in research and testing. The laboratory supports a wide range of materials, including glass, ceramics, and composites, tailored for microscopy, spectroscopy, and mechanical evaluation.

- **LABORATORY TAPE CASTER**
- **HOUSE BUILT EQUIPMENT FOR PREPARATION OF GLASS MICROSPHERES BY FLAME SYNTHESIS**
- **ATMOSPHERIC PLASMA POWDER PROCESSING EQUIPMENT**
- **COLD ISOSTATIC PRESS (CIP)**
- **DIP COATING EQUIPMENT**
- **SPIN COATING EQUIPMENT**

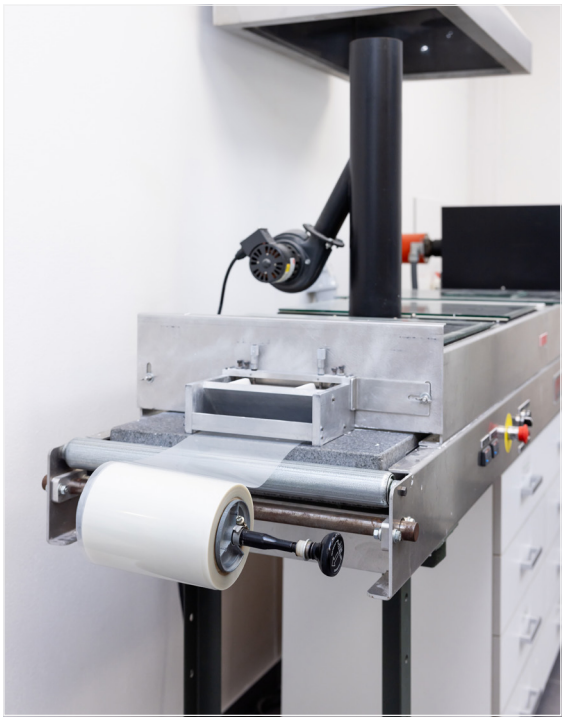
LABORATORY TAPE CASTER

FUNCTION AND USE:

Tape Caster has been designed specifically to meet the needs of the small developer and is ideal for lab scale studies. Lab-Cast is simple to use yet sophisticated enough to provide a versatile research and development platform.

TECHNICAL SPECIFICATION:

- Overall Length: 2.95 meters (9.66 ft)
- Casting Length: 2.13 meters (7 ft)
- Casting Width: Up to 300 mm (12 in)
- Casting Speed Range: 50 to 500 mm/min (2 to 20 in/min)



Model:
Lab-Cast Model TC-71LC

Responsible person:
Peter Švančárek, peter.svancarek@tnuni.sk

HOUSE BUILT EQUIPMENT FOR PREPARATION OF GLASS MICROSPHERES BY FLAME SYNTHESIS

FUNCTION AND USE:

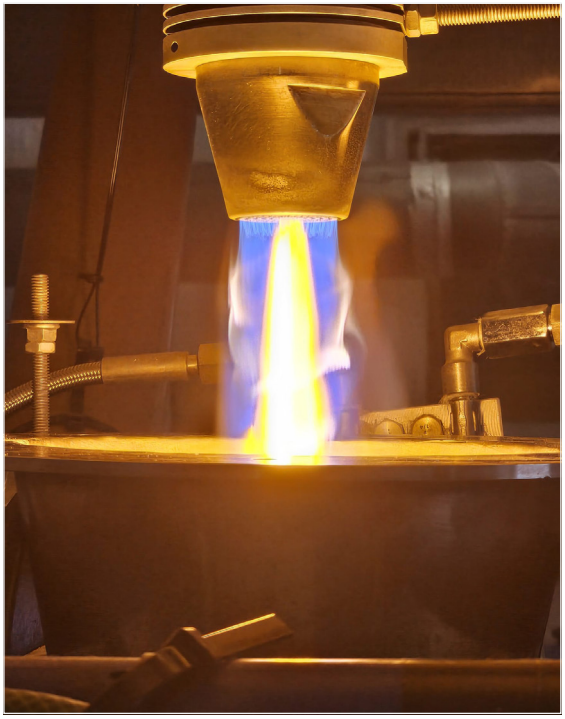
This equipment is engineered to produce various glass microspheres, including solid, hollow, and porous forms.

APPLICATIONS:

- Upcycling of diverse glass wastes into novel spherical particles
- Creation of advanced bioactive spherical particles for tissue engineering
- Development of specialized glass microspheres for optical applications
- Fabrication of specialized glass microspheres for brachytherapy
- Utilization of hollow glass microspheres as lightweight fillers
- Production of spherical particles for additive manufacturing processes
- Production of porous spherical particles for water treatment application
- Additional applications

TECHNICAL SPECIFICATION:

- Maximum flame temperature: 2 200 °C
- Precursor particle size: 10–120 microns
- Cooling process: deionized water
- Powder feeding: vacuum feeder with precise delivery of the precursor into the flame



Model:
FS01

Responsible person:
Jozef Kraxner, jozef.kraxner@tnuni.sk

ATMOSPHERIC PLASMA POWDER PROCESSING EQUIPMENT

FUNCTION AND USE:

The RPS400 is a unique generator of cold surface plasma in ambient air. The main element is a patented diffuse coplanar surface barrier discharge (DCSBD) plasma unit. It enables the generation of high power diffuse plasma, which is efficient for surface treatment of various planar and flexible materials (substrates, scaffolds, films, etc.). Furthermore, RPS400 is suitable for modifying surface characteristics including wetting, electrical charge, OH group concentration of both glass and ceramic powder samples for further application in coatings, 3D printing, biomaterials, etc. Powder samples treated by plasma in an air atmosphere enhance their surface characteristics so that their dispersion and deagglomeration when preparing suspensions is possible without the use of chemical dispersants.

TECHNICAL SPECIFICATION:

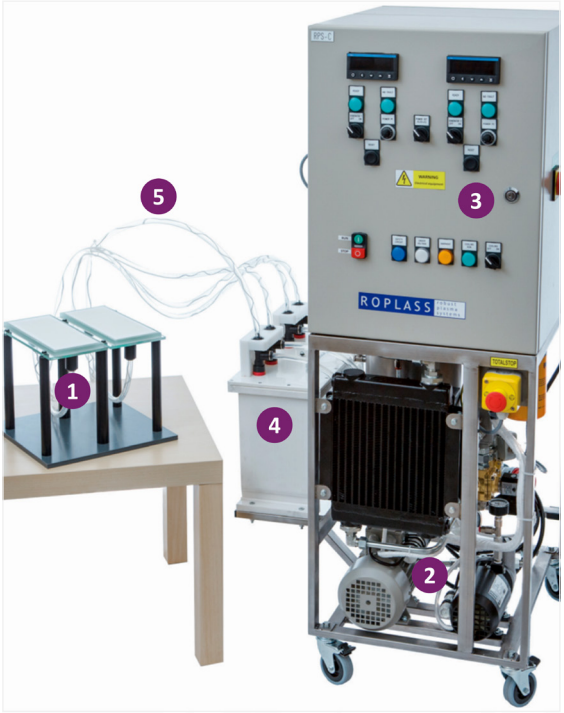
1. DCSBD plasma units
Patent-protected atmospheric pressure source of diffuse cold surface plasma.

2. Cooling system
Unique cooling system for keeping the cooling-medium (synthetic oil) ultra-dry and particle-free. The purity of the oil is essential for the proper functionality of the DCSBD plasma unit.

3. Power unit
Cutting-edge electrical switch-gear for operating the DCSBD plasma unit.

4. HV transformer
Transformer for transforming low-voltage to high-voltage (HV) for supplying DCSBD plasma unit.

5. HV wires and oil tubes
High-voltage wires and oil tubes are separated. High-voltage wires are safely insulated and embedded in dielectric cable protectors.



Model:
ROPLASS PLASMA SYSTEM: MODEL RPS2X400-15

Responsible person:
Zulema Vargas, zulema.vargas@tnuni.sk

COLD ISOSTATIC PRESS (CIP)

FUNCTION AND USE:

Cold isostatic pressing (CIP) is a convenient tool for producing powder compacts of advanced materials by applying uniform pressure. It is widely accepted as an effective forming method in ceramics and powder metallurgy. Cold isostatic pressing involves compacting powders, usually pellets (max. diameter 15 mm), by enclosing them in an elastomer mould. An elastomer mould is used because it has low resistance to deformation. Liquid pressure is then applied uniformly to the mould to compress it. You are left with a highly compact solid at the end of the process.

TECHNICAL SPECIFICATION:

- Maximum pressure: 1 000 MPa (1 GPa)
- Inner basket's diameter: 16 mm
- Compression/decompression speed: adjustable from 20 to 350 MPa/min

Model:
Stansted S-FL-850-12.5 -S

Responsible person:
Milan Parchovianský, milan.parchoviansky@tnuni.sk

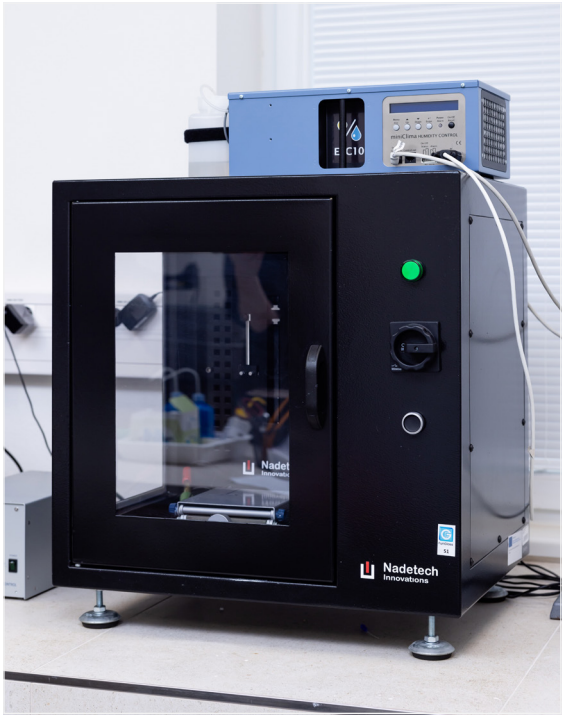
DIP COATING EQUIPMENT

FUNCTION AND USE:

Dip coating is a widely used deposition technique for obtaining films, layers, and coatings. The Nadetech ND-DC Dip Coater is an automated unit fabricating thin films and coatings via dip coating. Its design and programmable software permit the control and automation of every deposition parameter with high accuracy and reproducibility. The ND-DC achieves coatings with one or multiple layers through dip coating techniques, such as sol-gel, polymeric layers, self-assembled monolayers, biofilms, and other layers and coatings.

TECHNICAL SPECIFICATION:

- Vertical immersion range: 0–150 mm
- Minimum speed: 0.01 mm/min
- Maximum speed: 150 mm/min
- Programmable functions: immersion and retrieval speeds, vertical displacement, initial substrate position, immersion time and drying time
- Accessories – cabin, multisample holder, humidity & temperature sensor, pH sensor, magnetic stirrer, touchscreen



Model:
Nadetech ND-DC Dip Coater 150

Responsible person:
Milan Parchovianský, milan.parchoviansky@tnuni.sk

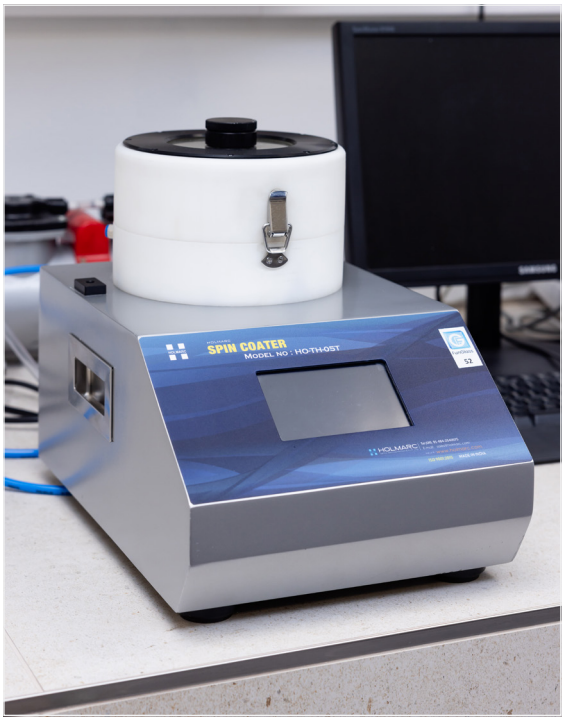
SPIN COATING EQUIPMENT

FUNCTION AND USE:

Spin coating is a procedure used to deposit uniform thin films, layers, and coatings onto flat substrates. Usually, a small amount of coating material in liquid form is applied to the substrate's centre, either spinning at low speed or not spinning at all. The substrate is then rotated to spread the coating material by centrifugal force. Holmarc's Spin Coater is a dedicated tabletop system that spin coats small substrates in research laboratories with well-controlled spin process parameters. The high speed and duration range allows the user to achieve the desired thickness or thinness of the film. A vacuum chuck powered by an oil-less vacuum pump holds the substrate at the spinning head.

TECHNICAL SPECIFICATION:

- Spinning speed: 60–9 999 rpm
- Substrate diameter: 30–70 mm
- Spin chamber: Nylon
- Acceleration: 5–2 000 rpm/sec
- Spinning Speed Accuracy: < 5%
- Programmable parameters: speed, acceleration, dwell time and number of steps
- Maximum no. of steps: 9
- Program memory: 9 programs (non–volatile)
- Dimension: 400 mm (D) × 275 mm (W) × 331 mm (H)



Model:
Holmarc HO-TH-05

Responsible person:
Milan Parchovianský, milan.parchoviansky@tnuni.sk

OTHER EQUIPMENT

Laboratory fume hood for work with hydrofluoric acid
N – DIG N-1200/900 M2 MERCI

Low Speed Saw
Buehler IsoMet

Semi-Automatic Grinder-Polisher
Buehler MiniMet 1000

Vibratory Polisher
Buehler VibroMet 2

Laboratory Planetary Mill
Fritsch Pulverisette 5

Vibratory Sieve Shaker
Retsch AS 200 Control

Grinder-Polisher with automatic polishing suspension dispenser
Buehler EcoMet 300 Pro/AutoMet 300

Automatic & Manual Abrasive Cutter
AbrasiMatic 300

Linear Precision Saw
Buehler IsoMet 5000

Carbon Sputter-Coater
JEOL JEC-530

AUTO Sputter-Coater
JEOL JFC-1300

Manual 15t Hydraulic Press

Hot Mounting Press
Buehler SimpliMet 1000

Sputter-coater
Quorum Q150V ES plus

Grinder-Polisher
Buehler EcoMet 300

Grinder-Polisher
Struers TegraPol-35/TegraForce-5

Heat treatment and glass melting facilities

These facilities provide precise control over thermal processing of glass and ceramic. Equipped with high-temperature furnaces, it enables controlled melting, annealing, crystallization and sintering of glass and ceramics.

- **HOT PRESS**
- **VERTICAL TUBE OBSERVATION WITH CCD CAMERA**
- **PRESSURE AUTOCLAVE**
- **CLIMATIC CHAMBER**
- **MELTING FURNANCE WITH CONTROLLED ATMOSPHERE**

HOT PRESS

FUNCTION AND USE:

The hot press enables the sintering and production of small samples (d=12 mm, 20 mm), especially from powder materials under high temperatures and pressure. The equipment has graphite heating elements. The maximum operating temperature is up to 1 800 °C and pressures up to 30 MPa in inert atmospheres (Ar, N) or under vacuum.

TECHNICAL SPECIFICATION:

- External dimensions: 600 × 800 × 1000 mm
- Internal dimensions: ø 40 × 50 mm
- Maximum temperature: 1 800 °C
- Maximum pressure: 30 MPa (300 bar)
- Heating elements: graphite heating elements
- Heating speed: max. 30 °C/min
- Machine power: 12 000 W
- Voltage: 3 × 230/400 V + N + PE
- Graphite moulds for powders: diameter 12 and 20 mm

Model:
Clasic 0220 ZL

Responsible person:
Milan Parchovianský, milan.parchoviansky@tnuni.sk

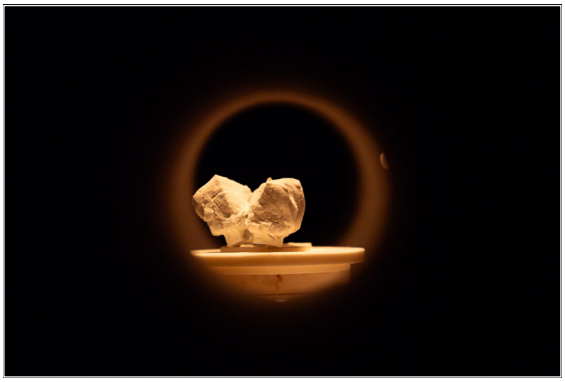
VERTICAL TUBE OBSERVATION FURNACE WITH CCD CAMERA

FUNCTION AND USE:

The device is designed for high-temperature process monitoring. It enables the observation of glass melting, including the fining and foaming processes. Additionally, the furnace allows for the visual inspection of sintering processes at temperatures of up to 1 650 °C.

TECHNICAL SPECIFICATION:

- Equipped with a programmable temperature controller up to 1 650 °C with a maximum heating rate of 10 °C
- Image is captured by a Pixelink digital camera using image analysis software



Model:
Clasic - vertical furnace

Responsible person:
Jozef Kraxner, jozef.kraxner@tnuni.sk

PRESSURE AUTOCLAVE

FUNCTION AND USE:

This high-pressure reactor system is designed for reactions and various applications under pressure, such as hydrothermal reactions, materials testing, thermal pressure hydrolysis, and corrosion testing. It is equipped with a high-torque magnetic drive for efficient mixing and stirring during the process media. The Hastelloy® reactor ensures high resistance against acids.

TECHNICAL SPECIFICATION:

- Reactor volume: 50 ml
- Max. pressure: 350 bar
- Temperature range: -20 °C to +350 °C

Model:
Büchi Glass Uster / Limbo li

Responsible person:
Aleksandra Nowicka, aleksandra.nowicka@tnuni.sk

CLIMATIC CHAMBER

FUNCTION AND USE:

Climatic chamber is designed for simulating various temperature and humidity environment for high and low temperature and humidity test, temperature cycling, dump heat, dew test and reliability on biological items, industrial products, materials electronic devices and components.

TECHNICAL SPECIFICATION:

- Temperature range: -40 °C to +180 °C
- Humidity range: 10%–95%
- Internal dimensions: 548 mm (W) × 447 mm (D) × 447 mm (H)

Model:
Angelantoni Discovery DY110

Responsible person:
Aleksandra Nowicka, aleksandra.nowicka@tnuni.sk

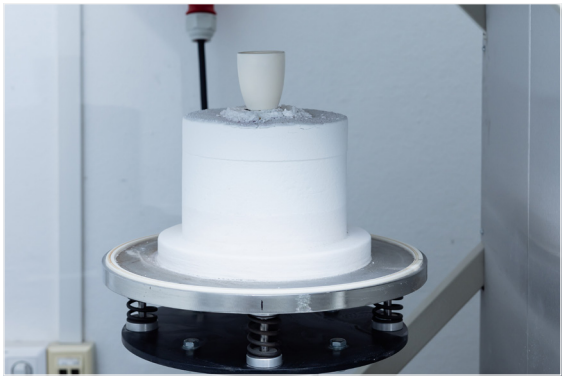
MELTING FURNACE WITH CONTROLLED ATMOSPHERE

FUNCTION AND USE:

The vacuum furnace is suitable for the preparation of glass with the possibility of mixing the wort, and it is also suitable for firing various materials in the selected inert atmosphere.

TECHNICAL SPECIFICATION:

- Vacuum vessel: air-cooled, made of 5 mm thick austenitic chrome-nickel steel, TIG-welded under argon
- Construction: the lower and upper lids are attached to the furnace shell with gasketed flanges
- Thermal insulation: made of 100 mm thick fibrous corundum, resistant to temperatures up to 1 850 °C
- Heating system: 8 high-temperature heating elements
- Fusion chamber dimensions:
  - Inner diameter: 180 mm
  - Height: 190 mm
- Operating temperature: Continuous operation at 1 600 °C
- Control system: equipped with a programmable control system supporting at least 60 programs, each containing up to 40 instructions



Model:
CLASIC 0618 VAK

Responsible person:
Mária Chromčíková, maria.chromcikova@tnuni.sk

OTHER EQUIPMENT

Tube furnace for work in vacuum/controlled atmosphere up to 1800°C
Clasic 0118T

High-temperature elevator furnace
Clasic 0718E

Tube furnace up to 1200 °C
Clasic 0213T

Chamber furnace for sintering of ceramics up to 1800°C
Clasic 1018 S

High Temperature Laboratory Oven
GHIBLI GH60

Muffle furnaces

Physical properties of solids/melts

This laboratory is dedicated to measuring essential physical properties, including density, viscosity, surface tension, hardness, and the mechanical strength of both solid and molten materials. This facility plays a vital role in understanding how materials behave under various conditions, which is crucial for processing glass and developing applications.

- **HIGH TEMPERATURE ROTATION VISCOMETER**
- **GRADIENT FURNACE**
- **HOUSE-BUILT EQUIPMENT FOR MEASUREMENT OF PHYSICAL PROPERTIES OF GLASS MELTS**
- **POTENTIOSTAT WITH FREQUENCY ANALYSER**
- **UNIVERSAL TEST EQUIPMENT FOR CHARACTERISING THE MECHANICAL PROPERTIES OF MATERIALS**
- **AUTOMATIC GAS ADSORPTION ANALYZER & SPECIFIC SURFACE AREA MEASUREMENT (BET)**
- **HELIUM PYCNOMETER**
- **EQUIPMENT FOR MEASUREMENT OF THERMALLY STIMULATED DEPOLARISATION CURRENTS**
- **DROP SHAPE ANALYZER**
- **EQUIPMENT FOR COATING OF SOLUTIONS AND SUSPENSIONS BY SPRAY TECHNOLOGY**
- **RHEOMETER / VISCOMETER**

HIGH TEMPERATURE ROTATION VISCOMETER

FUNCTION AND USE:

The high temperature viscometers VIS 403 and VIS 403HF measure the dynamic viscosity of materials with Newtonian behavior such as glasses, slags or mold powder. The instrument operates by measuring the shear stress and shear rate of a rotating bob immersed in a fluid filled cup under controlled temperature.

TECHNICAL SPECIFICATION:

- Viscosity η: 10–10^7 dPA·s
- Temperature Range: RT to 1 500 °C or 100 °C to 1 700 °C
- Temperature Resolution: 0.1 °C
- Sample volume: 13.8 or 9.2 cm^3
- Rotor diameter: 9 or 19 mm
- Measuring system material: Pt/Rh 30%
- Torque Range: 0.1 to 50 mN·m
- Torque Accuracy: ±1%
- Angular Velocity: max. 80 rad/s
- Angular Velocity Resolution: 10^{-4} rad/s
- Atmosphere: air, inert gas

Model:
BAHR Vis 403

Responsible person:
Ali Talimian, ali.talimian@tnuni.sk

GRADIENT FURNACE

FUNCTION AND USE:

The Gradient Heating Furnace (GHF) is a furnace that contains various heating blocks. Their positions and temperatures can be independently controlled, and various temperature profiles can be realized. We typically use it to perform controlled heat treatment at multiple temperatures at once on a variety of glasses and phosphor/ceramic materials.

TECHNICAL SPECIFICATION:

- International dimensions: 333 × 600 mm
- Maximum temperature: 1 550 °C
- Operating temperature: 1 500 °C
- Insulating lining: Ultraboard 1 750
- Temperature regulator: CLARE 4.0
- Heating speed: min. 1 °C/min
- Device power: 2 000 W
- Working temperature: 20 °C to 1 550 °C

Model:
Clasic 4015 SP

Responsible person:
Branislav Hruška, branislav.hruska@tnuni.sk

HOUSE-BUILT EQUIPMENT FOR MEASUREMENT OF PHYSICAL PROPERTIES OF GLASS MELTS

FUNCTION AND USE:

The KOM apparatus is a primary device designed to measure the density and electrical conductivity of glass melts. KOM features programmable temperature control, allowing operation up to 1 550 °C. The method used for determining glass density is well-suited for rapid verification of production process accuracy.

TECHNICAL SPECIFICATION:

Specific electrical conductivity is measured using an automatic RLC bridge (model BM595, Tesla Brno), operating with 50 mV AC at a frequency of 20 kHz. The measuring electrodes are circular in shape and made of platinum-rhodium alloy (Pt-Rh).

Model:
House-built equipment for measurement of physical properties of glass melts

Responsible person:
Branislav Hruška, branislav.hruska@tnuni.sk

POTENTIOSTAT WITH FREQUENCY ANALYZER

FUNCTION AND USE:

(a) ModuLab XM ECS

The electrochemical system (ECS) is a highly versatile electrochemical test system that measures the characteristics of a wide range of electrochemical systems including organic/inorganic, specialized corrosion, electroplating and energy cells.

For testing energy devices the system is able to conveniently measure time domain (DC) and impedance characteristics of complete cells, or of individual cells in a high voltage stack, or individual anodes and cathodes within cells using its integrated auxiliary channel measurement capability.

Electrochemical cells were assembled using a three-electrode system: reference electrode – Ag/AgCl, counter electrode – Pt electrode, working electrode – samples coated on a steel substrate or glass slides.

(b) ModuLab XM MTS

The Materials Test System (MTS) test combined electrical, thermal, and mechanical properties of dielectrics, insulators and electronic materials. These systems include specialized accessories: high voltage amplifiers, cryostats, furnaces, and sample holders for liquids, powders, and solid materials. Sample preparation: two platinum electrodes (5 mm/10 mm).

TECHNICAL SPECIFICATION:

EchemLab XM includes the following reference grade system components:

- Potentiostat / Galvanostat (8 V, 300 mA, 1 MHz bandwidth)
- Potentiostat auxiliary channels that can be used for anode / cathode and stack testing
- Frequency response analyzer (1 MHz bandwidth)
- EchemLab can also include a 100 V/100 mA amplifier for high voltage applications. This variant also includes a set of high voltage auxiliary channels for testing cells in a stack at up to 100 V
- Optional external power boosters for testing high power cells

Model:
AMETEK; Solartron Analytical ModuLab XM; ECS&MTS System

Responsible person:
Akansha Mehta, akansha.akansha@tnuni.sk

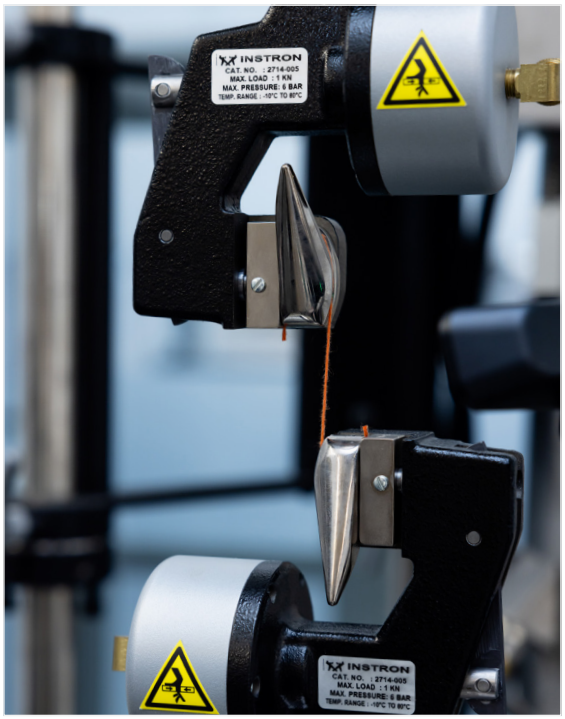
UNIVERSAL TEST EQUIPMENT FOR CHARACTERISING THE MECHANICAL PROPERTIES OF MATERIALS

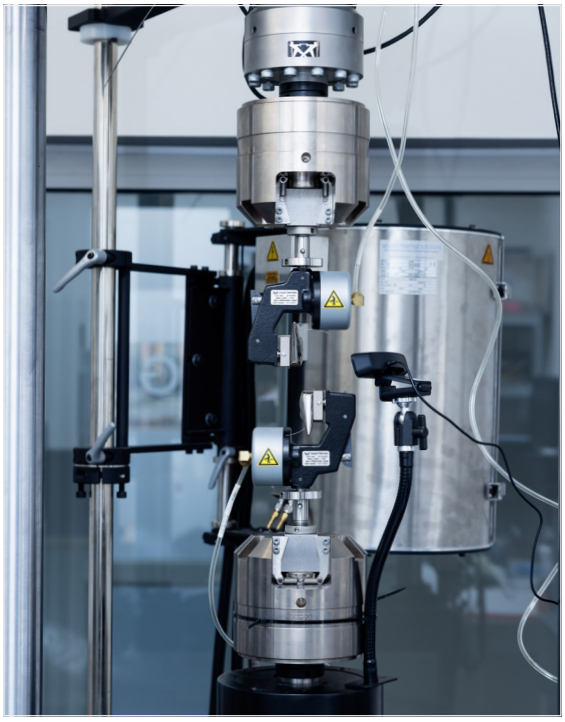
FUNCTION AND USE:

Equipment for testing the mechanical properties of prepared materials at laboratory and elevated temperatures, in particular flexural strength, compressive strength, high temperature strength, resistance to high temperature deformation (creep).

TECHNICAL SPECIFICATION:

Measurements with loads up to 100 kN and with servo-electric actuator with a movement speed from 1 µm/h to 100 mm/min, and load cells allowing accurate measurements of force between ±0.2 N to ±100 kN in compression and tension. The testing fixtures allow measurements in tensile, compression, bending, fibers strength, and fracture toughness according to ASTM and European norms. The device is equipped with high-temperature furnace (up to 1 500 °C).





Model:
INSTRON 8862 ±100 kN Dynamic Testing System

Responsible person:
Ali Talimian, ali.talimian@tnuni.sk

AUTOMATIC GAS ADSORPTION ANALYZER & SPECIFIC SURFACE AREA MEASUREMENT (BET)

FUNCTION AND USE:

Autosorb iQ is the most advanced and flexible multifunctional, fully automatic gas adsorption analyzer, with 1 micropore analysis station, covering specific surface area and pore size distribution analysis using BET, t-plot, BJH and NLDFT methods. It is possible to perform various physisorption and chemisorption analysis. The autosorb iQ performs the most challenging measurements of non-porous, mesoporous, and microporous materials with accuracy and precision.

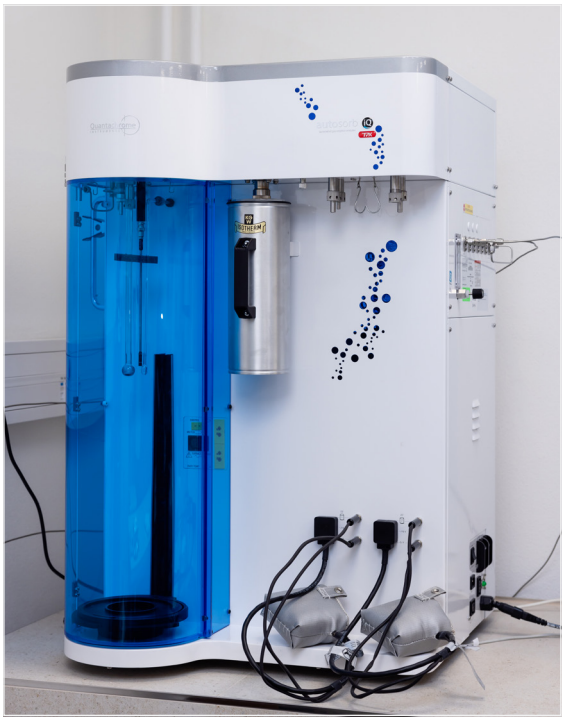
TECHNICAL SPECIFICATION:

The autosorb iQ operates by measuring the quantity of gas adsorbed onto or desorbed from a solid surface at some equilibrium vapor pressure by the static volumetric method. The data are obtained by admitting or removing a known quantity of adsorptive gas into or out of a sample cell containing the solid adsorbent maintained at a constant temperature below the critical temperature of the adsorbate. As adsorption or desorption occurs the pressure in the sample cell changes until equilibrium is established. The quantity of gas adsorbed or desorbed at the equilibrium pressure is the difference between the amount of gas admitted or removed and the amount required to fill the space around the adsorbent (void space).

The autosorb iQ AG has the capability of measuring adsorbed or desorbed volumes of nitrogen at relative pressures (P/Po) in the range 0.001 to slightly less than 1.0. When the micropore options are added, the lower limit is extended to $1x10^{-7}$ or $1x10^{-8}$. This volume-pressure data can be reduced by the autosorb iQ software into BET surface area (single and/or multipoint), Langmuir surface area, adsorption and/or desorption isotherms, pore size and surface area distributions, micropore volume and surface area using an extensive set of built-in data reduction procedures.

ASiQwin software interfaces the autosorb iQ to a computer for data acquisition, data reduction, and archiving.

The autosorb iQ has the ability to analyse physisorption for 90 hours without the need for refrigerant recharge.



Model:
QUANTACHROME INSTRUMENTS AUTOSORB IQ-C-XR (1 STAT.)

Responsible person:
Zulema Vargas, zulema.vargas@tnuni.sk

HELIUM PYCNOMETER

FUNCTION AND USE:

Automatic gas pycnometer working in He atmosphere, used for measurement of true density and volume of solids.

Measurement of samples:
- Pieces (bulks)
- Powders
- Fine powders (particle size from 50 nm to 50 µm)
- Porous samples

TECHNICAL SPECIFICATION:

- Volume of measured samples: range 1–135 cm^3
- Measurement accuracy: ±0.001 g/cm^3
- Output data: txt format
- Protocol: pdf form

Model:
Quantachrome Ultrapyc 1200e

Responsible person:
Anna Prnova, anna.prnova@tnuni.sk

EQUIPMENT FOR MEASUREMENT OF THERMALLY STIMULATED DEPOLARISATION CURRENTS

FUNCTION AND USE:

Many key aspects of materials properties, e.g., molecular relaxations, phase transitions, glass temperatures, rate of curing, etc., are investigated by TSDC. The Quatro Cryosystem can be used with sample cells for dielectric and impedance spectroscopy.

Methods:

- Thermally stimulated depolarization
- Thermally stimulated polarization
- Isothermal polarization time domain
- Isothermal conductivity time domain
- Relaxation map isotherm
- Relaxation map thermal window

TECHNICAL SPECIFICATION:

The Quatro Cryosystem:

- Temperature range: -160 °C to 400 °C
- Temperature ramps: -0.01 °C/min to 20 °C/min
- 0.01 °C temperature stability
- Low nitrogen consumption, typically 1 l/hr at T> -100 °C
- Control operation: from ambient to 400 °C

Sample Cell:

- Integrated precision Pt 100 temperature sensor
- Integrated interlock switch, enabling high voltage application only if mounted into the temperature environment
- Sample diameter up to 40 mm
- Sample thickness from 0 mm to 4 mm
- Particular electrical insulation properties, enabling the accurate sample current measurements down to 10 fA
- Temperature range: 200 °C to 250 °C

Model:
Novocontrol

Responsible person:
Katarína Faturíková, katarína.faturikova@tnuni.sk

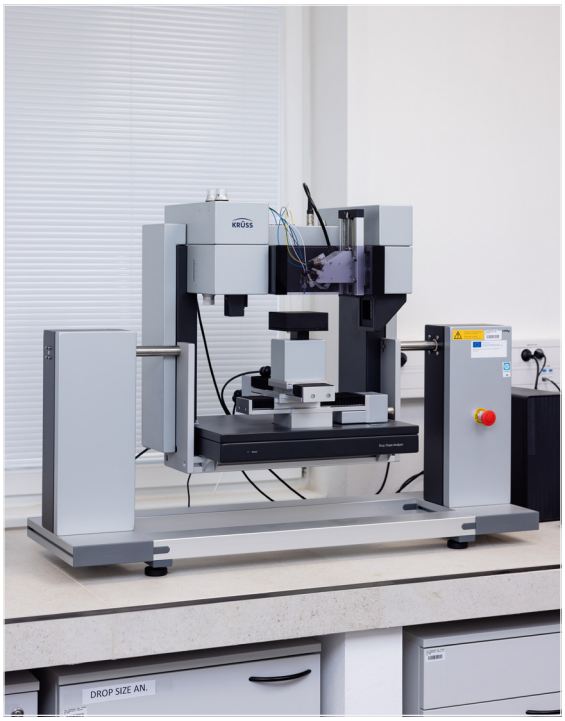
DROP SHAPE ANALYZER

FUNCTION AND USE:

The Expert version of the DSA100 Drop Shape Analyzer enables solids and liquids in wetting and coating processes to be analyzed comprehensively. The high degree of automation with easy programmable procedures provides the contact angle and surface tension (SFE) results. It is also frequently used due to its versatility, its dosing solution with four (optional: up to eight) test liquids, and its scientific tools for analyzing the solid/liquid contact.

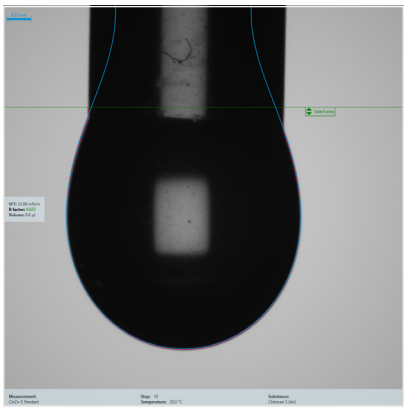
TECHNICAL SPECIFICATION:

- Sessile drop/captive bubble (contact angle 0 to 180 °C; conic section, polynomial, circle, Young-Laplace, height-width models)
- Surface free energy of solids (models: equation of state, Zisman, Fowkes, Wu, Owens-Wendt-Rabel-Kaelble, Schultz-1, extended Fowkes, acid-base theory)
- Pendant drop (interfacial and surface tension, 0.01 to 2 000 mN/m, Young-Laplace Model, types: static, dynamic)
- Maximum sample space: 320 mm (W) × ∞ (D) × 275 mm (H), without axes

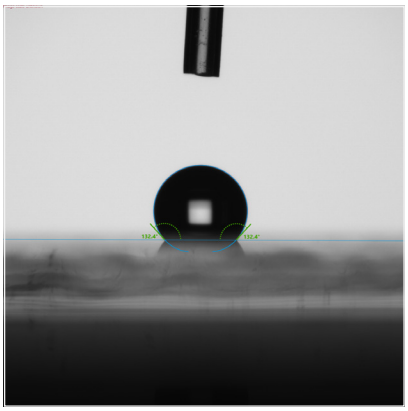


Model:
KRÜSS DSA100 Expert

Responsible person:
Katarína Faturíková, katarina.faturikova@tnuni.sk



Pendant drop



Sessile drop

Substance data

Drop phase:	water
Surrounding phase:	Air

Measurement data

Summary

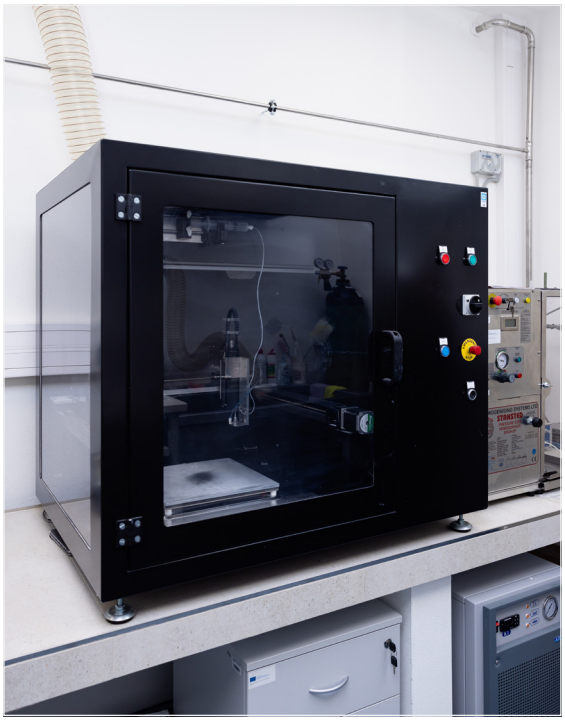
Mean CA(m)	50.75 (±1.53) °
Mean CA(l)	50.75 (±1.53) °
Mean CA(r)	50.75 (±1.53) °
Mean volume	1.708 (±0.155) µL
Mean temperature	20.0 (±0.0) °C
Mean diameter	2.60 (±0.10) mm
Mean pressure	-- bar
Mean three-phase point (l)	2.6 (±1.4) mm
Mean humidity	-- %
Mean three-phase point (r)	5.2 (±1.3) mm
SFT	245.26 (±218.37) mN/m
Mean shape parameter	0.50 (±0.31)

Report data

EQUIPMENT FOR COATING OF SOLUTIONS AND SUSPENSIONS BY SPRAY TECHNOLOGY

FUNCTION AND USE:

The spray coater is a multifunctional industrial instrument employed for the purpose of depositing a uniform and thin film of liquid or suspension onto a given surface. The ND-SP-Precision Spray Coater operates by applying pressure to the material, causing it to atomize into small droplets or particles. These particles are subsequently dispersed over the desired substrate by a spraying mechanism. These mechanisms guarantee consistent distribution, accurate regulation of thickness, and effective utilisation of materials. The temperature of the substrate bed can be controlled up to a maximum of 250 °C.



Model:
ND-SP Precision Spray Coating

Responsible person:
Ashokraja Chandrasekar,
ashokraja.chandrasekar@tnuni.sk

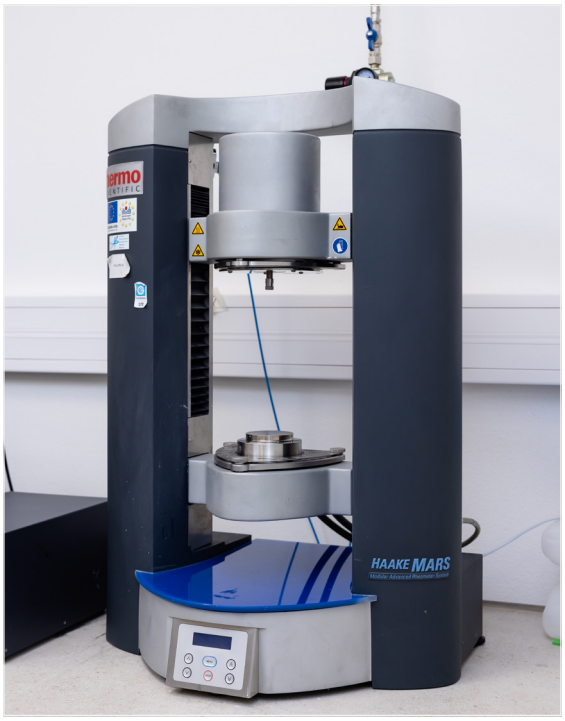
RHEOMETER / VISCOMETER

FUNCTION AND USE:

Temperature modules with enhanced temperature control accuracy and expanded temperature module range for applications like starch and polymers. Comprehensive accessory range to meet individual measuring needs like simultaneous measurements of rheology and, changes in the microscopic structure of samples (RheoScope Modul), and new measuring geometries and sample protection.

TECHNICAL SPECIFICATION:

- Pressure cells up to 400 bar
- Thermo Scientific™ RheoScope Module for the synchronous analysis of rheological properties and the microscopic structure of a sample
- CR, CS, CD mode in rotation
- CS and CD in oscillation



Model:
Haake Mars III

Responsible person:
Ali Talimian, ali.talimian@tnuni.sk

OTHER EQUIPMENT

Hot stage microscope
Zeiss

Micro Hardness Tester
WIKI 200

Equipment for determination of residual stresses in glass
STRAINOPTICS POLARIMETER SYSTEM – ANALYZER A-100

Powder deagglomeration equipment
HOMOGENISING SYSTEMS LTD SFP SPCH-18-EP

Laboratory mill for grinding solid materials
NETZSCH

Equipment for granulation of powders by spray technology
BÜCHI Labortechnik Mini Spray Dryer B-290

Programmable DC Power supply for Anodization and Electrophoretic deposition coatings
Keithley DC power supply 2200-72-1

Pull-Off Adhesion Tester
Elcometer 510 Automatic Pull-Off Adhesion Gauge

Microstructure characterisation

This laboratory is dedicated to investigating the structure of materials at micro and nanoscale levels. It employs advanced imaging and analysis techniques, such as optical and electron microscopy. These techniques enable the study of phase distribution, porosity, grain boundaries, and crystallite size, providing critical insights into material performance

- **OPTICAL MICROSCOPE**
- **CONFOCAL MICROSCOPE WITH THE POSSIBILITY OF INTERFEROMETRIC MEASUREMENTS**
- **ATOMIC FORCE MICROSCOPE**
- **PROFILOMETER**
- **SCANNING ELECTRON MICROSCOPE**

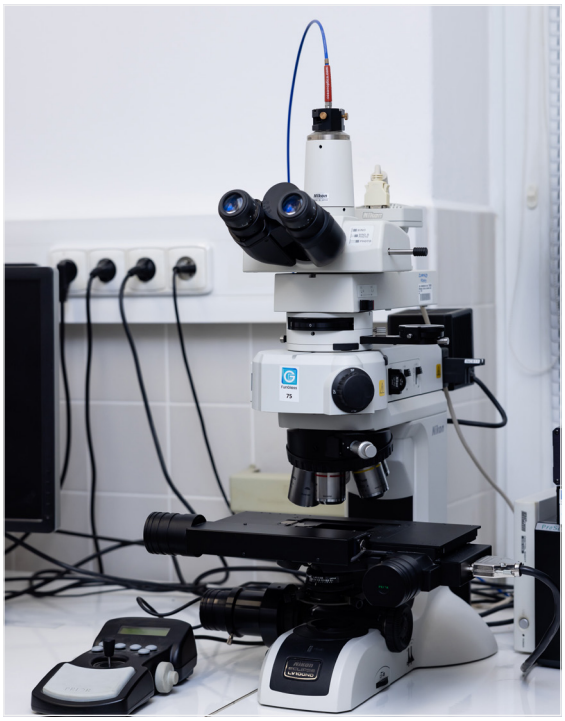
OPTICAL MICROSCOPE

FUNCTION AND USE:

The Nikon LV 100 UDM Microscope features both epipscopic and diascopic illumination that can be controlled independently. The light is produced through dual, 50 Watt lamphouses that are capable of producing light that is the equivalent to 100 Watt in other microscopes.

TECHNICAL SPECIFICATION:

It has both bright field and darkfield lighting techniques and is fitted with 5x, 10x, 20x, 50x and 100x objectives with a 1 000x total magnification capability.



Model:
NIKON LV 100 UDM

Responsible person:
Branislav Hruška, branislav.hruska@tnuni.sk

CONFOCAL MICROSCOPE WITH THE POSSIBILITY OF INTERFEROMETRIC MEASUREMENTS

FUNCTION AND USE:

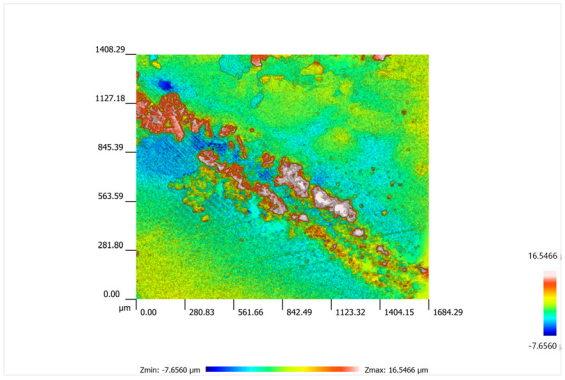
Confocal microscope enabling very fast and efficient 2D and 3D observation and precise evaluation of surfaces of solid bulk materials of irregular shape, thin films, fibres, powders, structures of various materials, i.e. characterization of prepared thin films in terms of their morphology and topography as well as basic optical properties and measurement of the thickness of transparent functional layers by interferometric measurement.

TECHNICAL SPECIFICATION:

- Achieves lateral resolution £ of 260 nm or 37 Mpix and Z-axis resolution £ of 10 nm
- Microscope shall be equipped with an LED or laser light source, with the possibility of extension to other sources with other wavelengths
- Equipped with a turret lens holder with a minimum of 5 positions
- 4 objectives with magnifications of 10x, 20x, 50x, 100x
- Microscope allows confocal 2D and 3D imaging of surfaces and enable observation of samples

Confocal microscopy process includes:

- Acquiring topographic data: The confocal microscope scans the surface at different depths and creates a series of images that are subsequently combined into a three-dimensional model
- Analyzing surface texture: These 3D models enable detailed analysis of surface texture, including measuring roughness and other surface parameters



Model:
Sensofar Metrology S NEOX

Responsible person:
Branislav Hruška, branislav.hruska@tnuni.sk

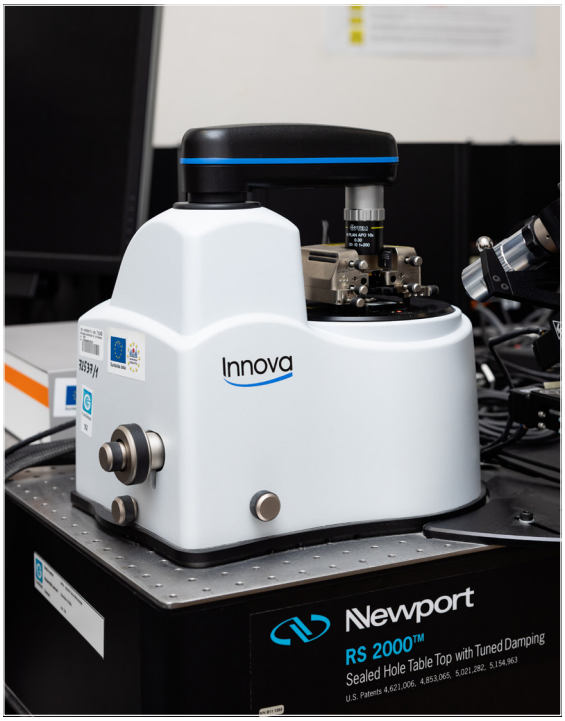
ATOMIC FORCE MICROSCOPE

FUNCTION AND USE:

The atomic force microscope is an instrument designed to detect local mechanical, thermo-mechanical and electrical properties of materials. Operational modes for analysis of samples in air and/or liquid: Contact mode/ lateral force microscopy, AC mode/tapping mode with phase control and Q-control function, electrical force microscopy, surface potential microscopy, magnetic forces, piezoresponse forces, tan δ loss angle imaging, force spectroscopy and mapping, nanolithography, nanomanipulation. The system shall have the capability of mapping and capturing force curves at high speed (at least 300 force curves per second).

TECHNICAL SPECIFICATION:

The system shall have the capability of mapping and capturing force curves at high speed (at least 300 force curves per second).



Model:
Innova®Atomic Force Microscope

Responsible person:
Branislav Hruška, branislav.hruska@tnuni.sk

PROFILOMETER

FUNCTION AND USE:

All necessary surface finish capabilities, such as the basic roughness and waviness characteristics, and form error analyses, are provided by the profilometer.

TECHNICAL SPECIFICATION:

- The instrument's vertical range and resolution are 1 mm and 16 nm, respectively
- Its 50 mm horizontal traverse is suitable for a wide range of applications

Model:
Taylor Hobson, Intra Touch

Responsible person:
Omid Sharifahmadian,
omid.sharifahmadian@tnuni.sk

SCANNING ELECTRON MICROSCOPE

FUNCTION AND USE:

Instrument for detailed chemical and microstructural analysis of ceramic composites, identification of the distribution of secondary phases in composites, identification and characterization of corroded surfaces and corrosion products of glass and ceramic materials, analysis of inhomogeneities in glass, characterization of crystallization products in the study of glass crystallization mechanisms.

TECHNICAL SPECIFICATION:

- Microscope type: SEM with field emission gun- Schottky type
- Accelerating voltage: 0.1 to 30 kV
- Resolution (SE): 1.0 nm (15 kV), 1.5 nm (1 kV) in GB mode
- Magnification: 25 to 1 000 000x (printed as a 120 × 90 mm micrograph)
- Beam current: 1 pA to 200 nA at 15 kV
- Aperture angle control lens: integrated
- Detectors: upper and lower detectors SEI, retractable LABe (BEI), EDXS, WDXS, retractable EBSD
- Energy Filter: in column r-filter for upper SE detector
- Gentle beam: integrated beam deceleration
- Digital images 1 280 × 960, 2 560 × 1 920, 5 120 × 3 840
- Specimen exchange chamber: single step loading/ unloading
- Specimen stage: eucentric, 5 axis motor drive

Model:
Scanning Electron Microscope, JEOL JSM-7600 F

Responsible person:
Peter Švančárek, peter.svancarek@tnuni.sk

OTHER EQUIPMENT

Optical Microscope
Nikon Eclipse ME 600

Analytical Scanning Electron Microscope with EDXS detector
JEOL JSM-IT500

Chemical analysis

This laboratory is equipped for qualitative and quantitative elemental analysis of materials. Using techniques like X-ray fluorescence (XRF), inductively coupled plasma (ICP), and wet chemistry methods, it determines the composition of raw materials, intermediates, and final products, ensuring precision in material development.

- **ION CHROMATOGRAPHY SYSTEM**
- **X-RAY PHOTOELECTRON SPECTROSCOPY (XPS)**
- **MICROWAVE DIGESTION SYSTEM**
- **INDUCTIVELY COUPLED PLASMA OPTICAL EMISSION SPECTROSCOPY (ICP-OES)**
- **INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY**
- **LASER ABLATION SYSTEM**
- **X-RAY FLUORESCENCE SPECTROMETER**

ION CHROMATOGRAPHY SYSTEM

FUNCTION AND USE:

Ion chromatography system DIONEX ICS-5000+ is designed to measure concentration of ionic species in the liquid samples by separating them based on their interaction with a stationary phase and next elution with extraction liquid running through the column. Ionic species are separated differently depending on species type and size.

The current configuration is set up for the qualitative and quantitative determination of anions (chloride, fluoride, bromide, phosphate, nitrate, nitrite and sulfate) and cations (lithium, sodium, ammonium, potassium, calcium and magnesium) in various liquid matrices.

TECHNICAL SPECIFICATION:

- Isocratic pump flow
- Conductivity detector
- AS-DV autosampler
- Chromeleon 7 System Control
- 2 mm diameter columns AS14, CS12A, guard columns AG14, CG12A

Model:
TIon chromatography system Dionex™ ICS-5000+

Responsible person:
Lenka Buňová, lenka.bunova@tnuni.sk

X-RAY PHOTOELECTRON SPECTROSCOPY (XPS)

FUNCTION AND USE:

This system offers fully automatic surface analysis with high throughput, providing detailed chemical and elemental information. XPS measures surface properties within a few atomic layers (1-10 nm), that differs from bulk composition analysis methods like energy dispersive spectroscopy (EDS). The primary functions of XPS include a) the composition of materials surfaces (element identification), b) the abundance of elements on surfaces (quantitative analysis), and c) chemical state measurement through binding energies of elements, which is related to the nature and strength of their chemical bonds. XPS is a versatile method and can characterize the surface of various materials, including minerals, organic compounds, semiconductors, thin films, and coatings for both research and industrial applications.

TECHNICAL SPECIFICATION:

- Powerful X-ray source (monochromated, microfocused, low power Al K-Alpha)
- X-ray spot size can be set between 10 to 400 µm (adjustable in 5 µm increments)
- Maximum sample range of 60 mm (L) × 60 mm (W), with sample thickness up to 20 mm
- Dual beam flood gun for reliable charge compensation
- Depth profiling of materials using EX06 monatomic ion source
- SnapMap feature enables quantified chemical stage images with high resolution
- Hemispherical analyzer with 128-channel detector, 180°, and double focussed
- Tilt module sample holder
- Fast sample loading and data acquisition
- Device control, data processing and reporting done through Avantage software

Model:
ThermoFisher Scientific Nexsa G2 surface analysis system

Responsible person:
Kamalan Mosas, kamalan.mosas@tnuni.sk

MICROWAVE DIGESTION SYSTEM

FUNCTION AND USE:

Microwave digestion system is designed to perform chemical digestion procedure under high pressure and temperature conditions. Using of a suitable digestion reagent at increased temperature in teflon vessels permeable with regard to microwaves, solid material is decomposed. Digestion solution are directly heated through the absorption of the microwave radiation by the polar digestion reagent. Sample preparation mainly for ICP spectroscopy procedures.

TECHNICAL SPECIFICATION:

- Pressure digestion at temperatures up to 230 °C (short term 300 °C) and pressures up to a max. of 100 bar
- Two rotors with two types of vessels DAP-100+ (chemical resistance to all mineral acids including hydrofluoric acid) and DAK-100/4
- Temperature and pressure monitoring of all samples in real time
- Up to 8/12 vessels/samples in one run
- Adapters for evaporating and concentrating digestion solutions

Model:
Berghof Speedwave 4

Responsible person:
Lenka Buňová, lenka.bunova@tnuni.sk

INDUCTIVELY COUPLED PLASMA OPTICAL EMISSION SPECTROSCOPY (ICP-OES)

FUNCTION AND USE:

The ICP-OES analysis technique (Inductively Coupled Plasma Optical Emission Spectroscopy) is an analytical method for the determination of most elements. The ICP-OES uses a high frequency inductively coupled plasma as a light source and is used for elemental analysis of sample solutions. It is a technology for the routine analysis of liquid samples and materials that can be converted to liquid form by dissolution or decomposition.

The ICP-OES 5100 with Synchronous Vertical Dual View (SVDV) can perform analysis in axial and radial views simultaneously thanks to Dichroic Spectral Combiner (DSC) technology.

TECHNICAL SPECIFICATION:

- DSC (Dichroic Spectral Combiner) – enables axial and radial viewing simultaneously
- Vertical torch – a simple torch loader mechanism
- autosampler SPS 4
- 5 channel peristaltic pump
- HF resistant introduction system
- Agilent ICP Expert Software

Model:
ICP-OES Agilent 5100SVDV

Responsible person:
Hana Kaňková, hana.kaňková@tnuni.sk

INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (ICP-MS)

FUNCTION AND USE:

The Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analytical method uses a high-frequency inductively coupled plasma as the ionization source and a mass spectrometer as the filtering device based on the mass-to-charge ratio. It is appropriate for elemental analysis of sample solutions, especially where the lowest detection limits are required.

The Agilent 7900 ICP-MS is a single quadrupole ICP mass spectrometer. Quadrupole with hyperbolic profile provides excellent ion transfer, resolution, and sensitivity.

TECHNICAL SPECIFICATION:

- Sample introduction: HF resistant introduction system, ultra high matrix introduction technology
- Interface: Pt and Ni sampling and skimmer cones
- Ion Lens: extraction lens, off-axis omega lens
- Octopole Reaction System: octopole, He cell mode
- Mass analyzer: Quadrupole mass spectrometer
- SPS 4 Autosampler
- Software: Agilent ICP-MS MassHunter- Method Setup Wizard, Batch-at-a-Glance data table view with real-time update

Model:
ICP-MS Agilent 7900

Responsible person:
Hana Kaňková, hana.kankova@tnuni.sk

LASER ABLATION SYSTEM

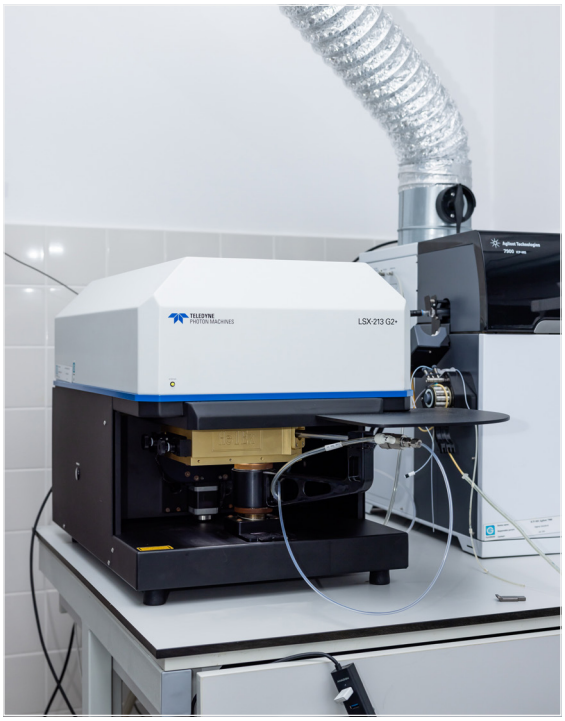
FUNCTION AND USE:

Laser ablation is used as a sampling method for elemental and isotopic analysis and replaces the traditional procedures usually required to transfer solid samples into solution. The process is based on the removal of material from a solid surface by irradiation with a pulsed laser beam.

The LSX-213 G2+ uses a specially designed Nd:YAG laser with a frequency five times the wavelength of 213 nm. Laser ablation is coupled with ICP MS 7900 Agilent.

TECHNICAL SPECIFICATION:

- Variable output energy (0–100%) and variable pulse repetition frequency (1–20 Hz)
- Variable laser spot size (4–200 µm)
- HelEx II Active 2-Volume Cell Compatible
- Laser cooler/power supply with remote control pendant
- Software: Chromium 2.4, Igor Pro



Model:
Teledyne LSX-213 G2+ Nd:YAG Laser Ablation System

Responsible person:
Hana Kaňková, hana.kaňková@tnuni.sk

X-RAY FLUORESCENCE SPECTROMETER

FUNCTION AND USE:

X-ray fluorescence spectrometer (XRF) is an analytical technique used to determine the elemental composition of materials. The principle is based on the measurement of the fluorescence (X-rays) emitted by the sample when excited by the primary X-ray source.

The Bruker S8 TIGER is based on Wavelength Dispersive X-ray Fluorescence (WDXRF), that provides qualitative and quantitative analysis. The laboratory has the possibility of preparing samples by pressing into pellets, melting with lithium tetraborate into fused beads or loose sample powder in He atmosphere.

TECHNICAL SPECIFICATION:

- Touch Control panel
- Automatic samples recognition
- QUANTEXPRESS software – standardless analysis method
- Wide range of crystals: XS-55, XS-B, LiF, LiF200, PET, etc.
- Automatic mask changer: 8–34 mm
- Proportional flow and scintillation counter
- Software: SpectraPlus

Model:
Bruker S8 Tiger

Responsible person:
Hana Kaňková, hana.kankova@tnuni.sk

Phase analysis

This laboratory focuses on identifying and quantifying both crystalline and amorphous phases. It employs X-ray diffraction (XRD) along with various other analytical techniques. The lab plays a vital role in studying phase transformations, crystallization behavior, and material stability, all of which are essential for enhancing the properties of glass and ceramics.

- **X-RAY POWDER DIFFRACTOMETER**
- **HIGH TEMPERATURE X-RAY DIFFRACTION CHAMBER**
- **X-RAY DIFFRACTOMETER FOR THIN FILM CHARACTERISATION**

X-RAY POWDER DIFFRACTOMETER

FUNCTION AND USE:

Qualitative and semi-quantitative analysis of the phase composition of materials, including starting materials for the preparation of glasses and ceramics, the phase composition of ceramic materials and composites, the phase composition of corrosion products on the surface of glasses and ceramics, the study of the kinetics of crystallization of glasses at high temperatures and the study of crystalline defects.

TECHNICAL SPECIFICATION:

- X-ray generator: 4 kW (max 60 kV, max 100 mA)
- Line/point focus switch: easy and quick, without tooling
- Smallest addressable increment: 0.0001°
- Angular reproducibility: < 0.0002°
- 2θ linearity over whole range: equal or better than ± 0.01°
- Maximum angular speed: 15 deg/s
- Angular resolution: 0.026° FWHM on LaB_6

Model:
X-ray powder diffractometer,
Panalytical Empyrean

Responsible person:
Michal Žitňan, michal.zitnan@tnuni.sk

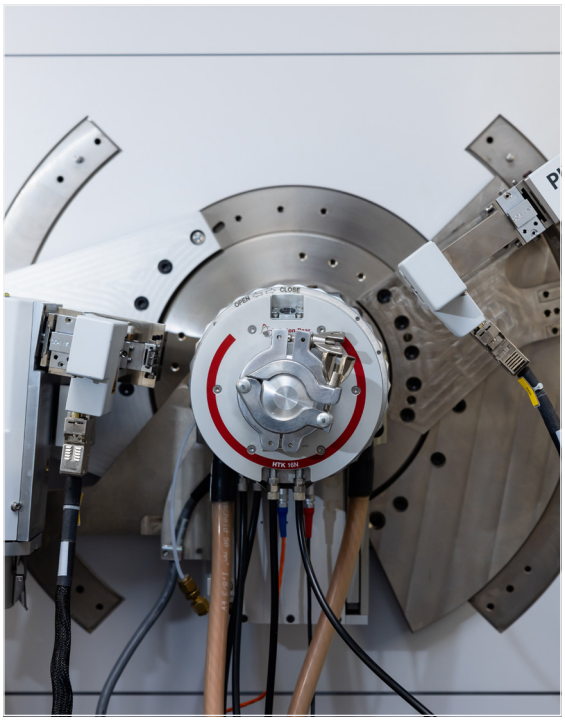
HIGH TEMPERATURE X-RAY DIFFRACTION CHAMBER

FUNCTION AND USE:

The HTK 16N high temperature chamber is instrument for in-situ X-ray diffraction studies up to 1 600 °C. The sample is directly heated with a Platinum heating filament.

TECHNICAL SPECIFICATION:

Tungsten heating filament for vacuum (≤ 2.10^{-4} mbar)	25 °C to 2 300 °C (HTK 2 000N)
Platinum heating filament (vacuum, air, inert gas)	25 °C to 1 600 °C (HTK 16N / HTK 2 000N)
Graphite heating filament for vacuum (≤ 2.10^{-4} mbar)	25 °C to 1 500 °C (HTK 16N)
Nitrogen	1 400 °C (HTK 16N)
Helium	1 300 °C (HTK 16N)



Model:
High temperature X-ray diffraction chamber Anton Paar HTK16

Responsible person:
Michal Žitňan, michal.zitnan@tnuni.sk

X-RAY DIFFRACTOMETER FOR THIN FILM CHARACTERISATION

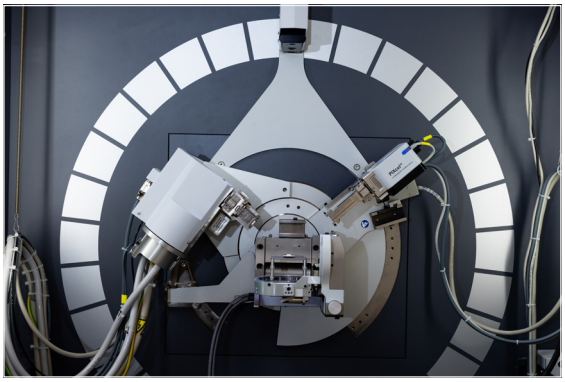
FUNCTION AND USE:

X-ray diffractometer for phase, stress and texture analysis of thin films on different types of substrates.

TECHNICAL SPECIFICATION:

X-ray diffractometer with a copper cathode (CuKα radiation, wavelength 0.15405 nm). The system is equipped with the following accessories and X-ray optics:

- Bragg-Brentano goniometer geometry
- 3-axis cradle
- Accessories for measurements in GISAXS mode
- SAXS apertures
- 3D PIXcel position-sensitive detector
- Scintillation detector
- Goniometer enabling simultaneous mounting of both detectors (position-sensitive and scintillation)



Model:
Empyrean III/Malvern Panalytical

Responsible person:
Michal Žitňan, michal.zitnan@tnuni.sk

Thermal analysis

This laboratory investigates the thermal behavior of materials using techniques such as differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), and dilatometry. It provides insights into phase transitions, thermal stability, expansion, and decomposition processes, essential for material processing and application.

- **THERMOMECHANICAL ANALYZER**
- **OPTICAL CONTACTLESS DILATOMETERCHAMBER**
- **SIMULTANEOUS THERMAL ANALYZER**
- **DIFFERENTIAL SCANNING CALORIMETRY (DSC)**

THERMOMECHANICAL ANALYZER

FUNCTION AND USE:

This advanced equipment for thermomechanical analysis enables precise examination of samples under a controlled atmosphere in air, nitrogen or vacuum, reaching temperatures up to 1 650 °C. It is particularly effective for exploring the volumetric and structural relaxation of oxide glasses, providing essential data for developing models of relaxation processes. Furthermore, it allows for the determination of key thermal properties, such as the glass transition temperature and glass softening temperature. This system is also valuable for conducting dilatometric studies of the sintering process in ceramic materials and composites within controlled atmospheres, facilitating insights into sintering mechanisms. Additionally, it supports the investigation of crosslinking and ceramization processes in organosilicate ceramic precursors, making it a versatile tool for materials research and development.

Model:
Thermomechanical Analysis Netzsch
TMA 402 F1 Hyperion

Responsible person:
Beata Pecušová, beata.pecusova@tnuni.sk

TECHNICAL SPECIFICATION:

- Steel furnace: from -150 °C to +1 000 °C, heating speed 0.1–50 K/min, cooling time (free cooling): from 1 000 °C to 100 °C/40 min
- SiC furnace: from 25 °C to 1 600 °C, heating speed 0.1K–50 K/min, cooling time: from 1 540 °C to 100 °C 60 min
- Holders: expansion, penetration, 3-point bending and tension
- Holder material: SiO_2 and Al_2O_3
- Expansion and penetration - max. sample dimensions: 30 mm (L) × 10 mm (Ø)
- 3 point bending - max. sample dimensions: 24 × 5 mm
- Tension - max. sample dimensions: 30 × 8 × 1 mm
- Force range: from 1 mN to 3 N/0.2 mN step
- Frequency: max. 1 Hz

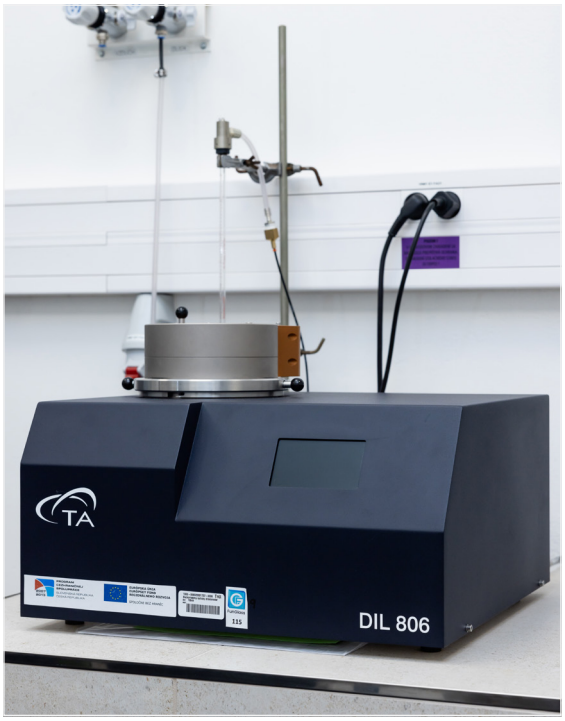
OPTICAL CONTACTLESS DILATOMETER

FUNCTION AND USE:

A versatile instrument for thermal expansion and contraction measurements, DIL 806 uses an innovative measurement principle to make unconventional experiments possible, and to improve many conventional tests. Contact-less dilatometric measurement allows the sample to freely expand/shrink without any interference due to mechanical contact. This results in a more precise determination of specimen's dimensional changes as well as of the temperature at which the events are detected. Also, the lack of any load due to the contact with a measuring system enables to extend the analysis well beyond softening point into the melt, and also analyze soft sample that would otherwise be impossible to test.

TECHNICAL SPECIFICATION:

- Sample length: 0.3–30 mm
- Sample height: max. 10 mm
- Change of length: max. 29 mm
- Length Resolution: 50 nm
- Temperature Resolution: 0.1°C
- Accuracy in α: 0.03 × 10^{-6} K^{-1}
- Temperature range: 25°C to 1 200°C
- Atmosphere: Vacuum, inert gas, air



Model:
DIL 806 Optical contactless dilatometer

Responsible person:
Jaroslava Gombárová,
jaroslava.gombarova@tnuni.sk

SIMULTANEOUS THERMAL ANALYZER

FUNCTION AND USE:

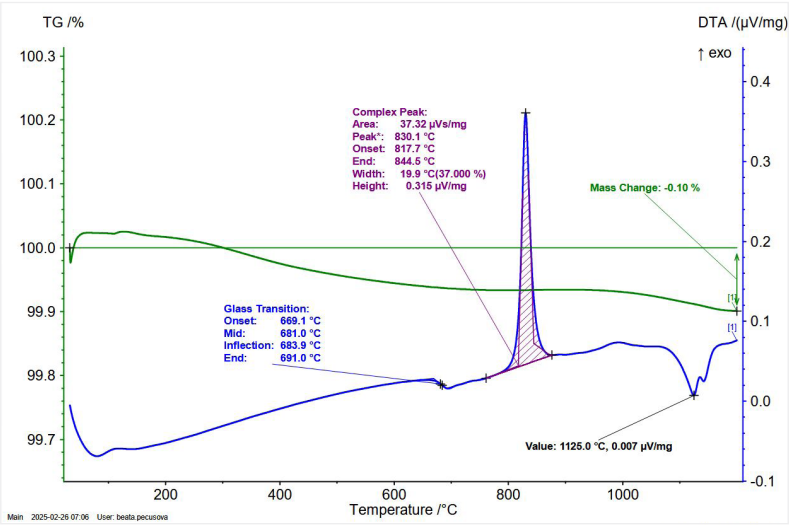
The simultaneous thermal analyzer STA 449 F1 Jupiter is a high-temperature device for simultaneous TG-DSC/DTA analysis, used to investigate the thermal behavior of substances. It is a multifunctional thermal analyzer with the possibility of measuring characteristics: TG thermogravimetry, differential scanning calorimetry calorimetry – DSC and differential thermal analysis – DTA, which enables measurements of phase transitions, modification transformations in the solid phase, crystallisation parameters, glass transition, melting point, determination of the purity of solid substances, weight changes and thermal stability.

Model:
Simultaneous Thermal Analysis Netzsch
STA 449 F1 Jupiter

Responsible person:
Beata Pecušová, beata.pecusova@tnuni.sk

TECHNICAL SPECIFICATION:

- Graphite furnace: 35 °C to 1 900 °C, heating rate 2–30 °C/min, cooling time (in He): from 1 900 °C to 35 °C/50 min
- Platinum furnace: 35 °C to 1 300 °C, heating rate 2–30 °C/min, cooling time (free cooling): from 1 300 °C to 35 °C/40 min
- Atmosphere: synthetic air and nitrogen
- Holders: TG (“S” thermocouple), TG-DSC (“S” thermocouple), TG (“W” thermocouple) and TG-DTA (“W” thermocouple)
- Crucibles: TG (0.5 ml/Al_2O_3; 3.4 ml/Al_2O_3; 0.3 ml/Al_2O_3); TG-DTA (0.3 ml/Al_2O_3); TG-DSC (85 ml/Al_2O_3; 85 ml/Pt/Rh)
- Crucible material: Al_2O_3 and Pt/Rh



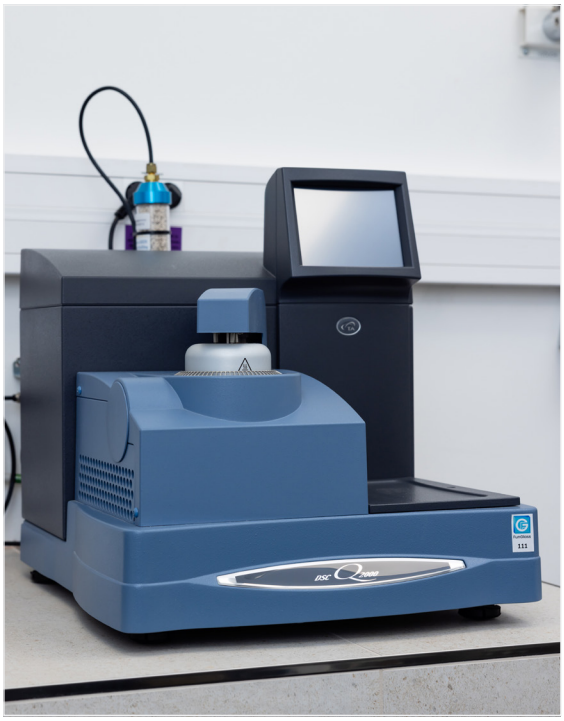
DIFFERENTIAL SCANNING CALORIMETRY (DSC)

FUNCTION AND USE:

Differential scanning calorimetry (DSC) is a thermal analysis technique that measures temperatures and heat fluxes associated with transitions in materials as a function of time and temperature. Such measurements provide qualitative and quantitative information about physical and chemical changes that include endothermic or exothermic processes.

TECHNICAL SPECIFICATION:

- Temperature Range: 25 °C to 600 °C
- Temperature accuracy: ±0.1%
- Crucible material: aluminum
- Atmosphere: air
- Sample size: 5–30 mg
- Heating rate: 0.1 °C to 30 °C/min
- Baseline curvature: 10 µW



Model:
TA Instruments, Q 2000

Responsible person:
Beáta Pecúšová, beata.pecusova@tnuni.sk

OTHER EQUIPMENT

Thermomechanical Analysis
TA Instruments TMA Q400

Differential scanning calorimetry
Perkin Elmer DSC 8500

Spectroscopy methods

A wide range of spectroscopic techniques, including UV-Vis, FTIR, Raman, and fluorescence spectroscopy, are available to analyze optical, chemical, and structural properties of materials. These methods provide essential information on molecular interactions, chemical bonding, and defect structures in glasses and ceramics.

- **HIGH-RESOLUTION SPECTROFLUOROMETER**
- **HIGH-RESOLUTION UV-VIS-NIR SPECTROPHOTOMETER**
- **RAMAN MICROSCOPE**
- **FT-IR SPECTROMETER**

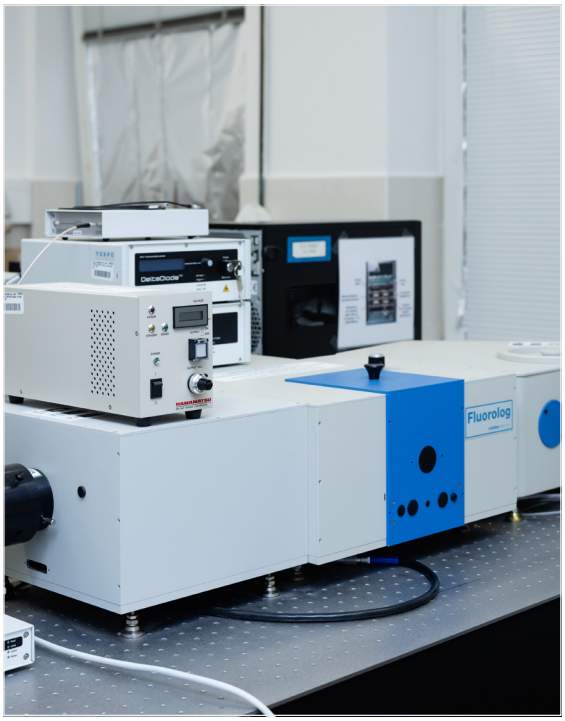
HIGH-RESOLUTION SPECTROFLUOROMETER

FUNCTION AND USE:

Fluorescence spectrometer for measurement of luminescence spectra, and change in luminescence over time of a sample, when irradiated with UV, visible or near-IR Light.

TECHNICAL SPECIFICATION:

- Samples: liquid, solid (powder, bulk, paste)
- Measurement type: steady state, time-resolved (TCSPC) from VIS-NIR spectral range (up to 3000 nm)
- Excitation: cw Xe lamp, flash Xe, pulse diode excitation (several lines from UV to NIR)
- Detector channels: VIS (PPD-900 (230–920 nm)), NIR (PMT (950–1 700 nm)), InGaAs (800–1 700nm, PbS(100–3 000 nm))
- Luminescence lifetime: from ns to seconds, in the VIS-NIR spectral range (up to 1 700 nm)
- Accessories: Integration sphere, He cryostat (steady state and time-resolved measurements down to 7 K), Dewar vessel (measurements at 77 K in liquid nitrogen) and further accessories



Model:
Spectrofluorometer Fluorolog 3: FL 3-21 (Horiba Jobin-Yvon)

Responsible person:
Robert Klement, robert.klement@tnuni.sk

HIGH-RESOLUTION UV-VIS-NIR SPECTROPHOTOMETER

FUNCTION AND USE:

Dual-beam UV-VIS-NIR spectrophotometer for measurement of materials spectral characteristics in the ultraviolet, visible and near-infrared range (175–3 300 nm).

TECHNICAL SPECIFICATION:

- Sample types: liquids, solids (powder, bulk, paste), thin films, surfaces
- Measurement modes: transmission, diffuse and specular reflectance, kinetics
- Wavelength range: 175–3 300 nm
- Photometric range (Abs): 8 Abs

ACCESSORIES:

- External DRA-2500: diffuse reflectance accessory for 200–2 500 nm
- Praying Mantis: diffuse reflectance accessory designed for small sample volumes
- VASRA (Variable Angle Specular Reflectance Accessory): measures relative specular reflectance of sample surfaces at angles of incidence between 20° and 70°
- VW (Absolute Specular Reflectance Accessory): measures absolute specular reflectance from smooth solid materials at near-normal incidence (7°)

Model:
Cary 5000 (Agilent Technologies)

Responsible person:
Robert Klement, robert.klement@tnuni.sk

RAMAN MICROSCOPE

FUNCTION AND USE:

The inVia system comprises a research-grade microscope coupled to a high-performance Raman spectrometer. It is simple to operate yet delivers outstanding performance - high signal throughput, combined with high spectral resolution and stability - giving reliable results, for even the most challenging measurements.

TECHNICAL SPECIFICATION:

- Spectral range: 50–4000 cm^{-1}
- Excitation laser sources: 514 nm, 532 nm, and 633 nm
- Spectral resolution: 0.3 cm^{-1} (FWHM)
- Highest typically necessary: 1 cm^{-1}
- Stability: < ±0.01 cm^{-1}
- Variation in the centre frequency of curve-fitted Si
- 520 cm^{-1} band, following repeat measurements
- Achieved using a spectral resolution of 1 cm^{-1} or higher
- Spatial resolution (lateral) 0.25 µm, standard: 1 µm
- Spatial resolution (axial) < 1 µm, standard: < 2 µm
- Detector size (standard): 1 024 pixel × 256 pixel

Model:
Raman Microscope Renishaw inVia Reflex

Responsible person:
Branislav Hruška, branislav.hruska@tnuni.sk

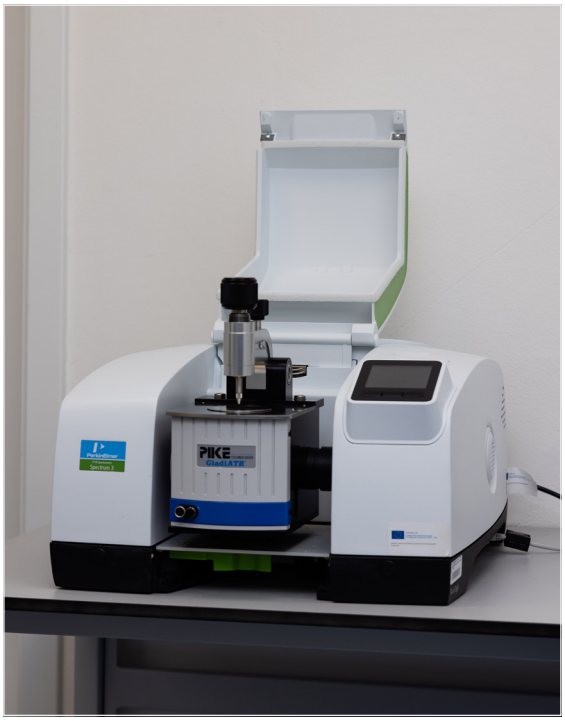
FT-IR SPECTROMETER

FUNCTION AND USE:

Identify and characterize materials (e.g., films, solids, powders, or liquids). Identify contamination on or in a material (e.g., particles, fibers, powders, or liquids). Analysis the chemical composition of smaller particles, typically 10-50 microns, as well as larger areas on the surface.

TECHNICAL SPECIFICATION:

- Spectral range: 7 800–225 cm^{-1}
- Spectral resolution: 0.4 cm^{-1}
- Wavelength accuracy: 0.02 cm^{-1} @ 2 000 cm^{-1}
- Signal-to-noise ratio better than 15 000:1 RMS
- Measurement moods: transmission/absorption; total attenuated reflection
- Optional accessories: universal ATR accessory Diamond/ZnSe with 1 reflection top-plate and pressure arm



Model:
Spectrum 3, Perkin-Elmer

Responsible person:
Jose Joaquin Velazquez, jose.velazquez@tnuni.sk

OTHER EQUIPMENT

Fluorescence spectrometer
Fluorocube-NL-01

NIR Fibre-optics spectrometer,
Ocean Optics NIRQUEST 256-2.5

Additive manufacturing

This laboratory focuses on advanced 3D printing techniques for glass and ceramic materials, enabling the development of complex structures with tailored properties. Utilizing direct ink writing, stereolithography, and binder-jet printing methods, it supports research in customized glass fabrication for industrial and biomedical applications.

- **EQUIPMENT FOR THE PRODUCTION OF HIGH-STRENGTH CERAMIC 3D STRUCTURES BASED ON PHOTOSENSITIVE CERAMIC MIXTURES**
- **3D PRINTER COMBINED WITH A DIRECT INK WRITING FABRICATION SYSTEM**
- **EQUIPMENT FOR THE PRODUCTION OF 3D STRUCTURES FROM POWDER-BASED MIXTURES**
- **FILAMENT EXTRUDER**

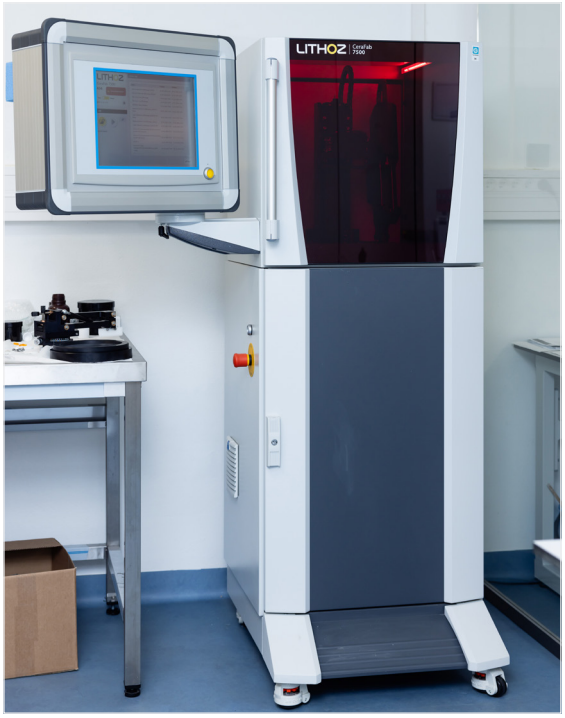
EQUIPMENT FOR THE PRODUCTION OF HIGH-STRENGTH CERAMIC 3D STRUCTURES BASED ON PHOTOSENSITIVE CERAMIC MIXTURES

FUNCTION AND USE:

Equipment for the production of high-strength ceramic three-dimensional structures based on photosensitive ceramic mixtures enabling 3D printing of complex structures and so-called "scaffolds" for biomedical applications, as well as materials with hierarchical porosity, e.g. for catalyst supports.

TECHNICAL SPECIFICATION:

- Production space size: 75 × 40 × 165 mm (x/y/z)
- Ability to print layers with thicknesses ranging from 25 to 100 µm
- Layer speed ≥ 100 layers per hour
- Horizontal print resolution of 40 µm (635 dpi)



Model:
LITHOZ CeraFab 7500 Research stereolithography system

Responsible person:
Arish Dasan, arish.dasan@tnuni.sk

3D PRINTER COMBINED WITH A DIRECT INK WRITING FABRICATION SYSTEM

FUNCTION AND USE:

The Prusa i3 MK3S is a Fused Deposition Modeling (FDM) 3D printer, which means it works by melting and extruding plastic filament layer by layer to create a 3D object.

Prusa i3 MK3S FDM printer for Direct Ink Writing (DIW) involves replacing the traditional filament-based extrusion system with a syringe-based ink deposition system. This allows printing with pastes, gels, or other viscous materials instead of thermoplastic filaments.

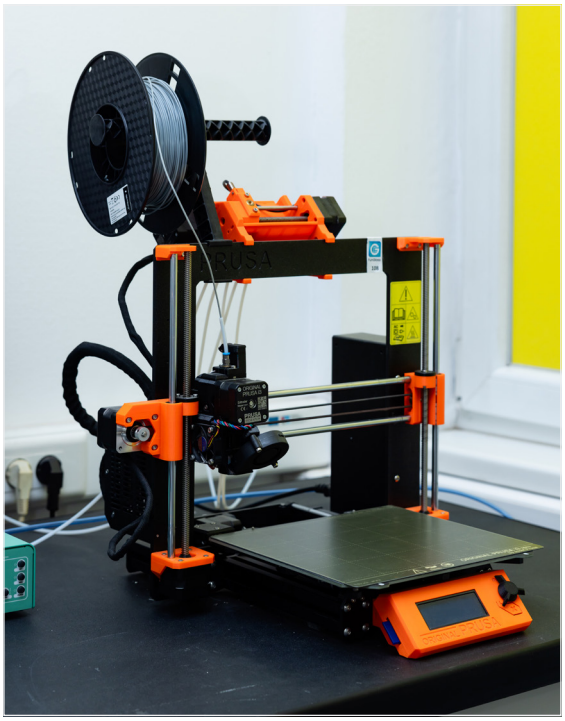
TECHNICAL SPECIFICATION:

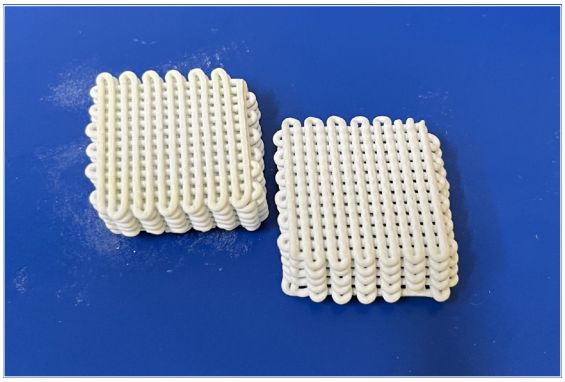
Basic Working Principle for FDM version

1. Material Feeding
   - The printer uses spooled plastic filament (commonly PLA, PETG, ABS, etc.).
   - The filament is pulled into the hot end through an extruder.
2. Melting & Extrusion
   - The hot end heats the filament (typically 190–250 °C, depending on the material).
   - The melted filament is pushed out through a nozzle onto the print bed.
3. Layer-by-Layer Printing
   - The printer's X, Y, and Z axes move precisely to position the nozzle.
   - The heated bed helps the first layer stick properly to avoid warping.
   - The printer builds the object layer by layer using a digital model (G-code).

Basic Working Principle for DIW version

1. Material Feeding
   - The printer uses various suspension-based ink (alkali-activated materials, glass, and ceramics fillers).
   - Two types of extrusion systems based on pneumatic and step motor.





Model:
Original Prusa i3Mk3S

Responsible person:
Abel Woldu Ourgessa, abel.ourgessa@tnuni.sk

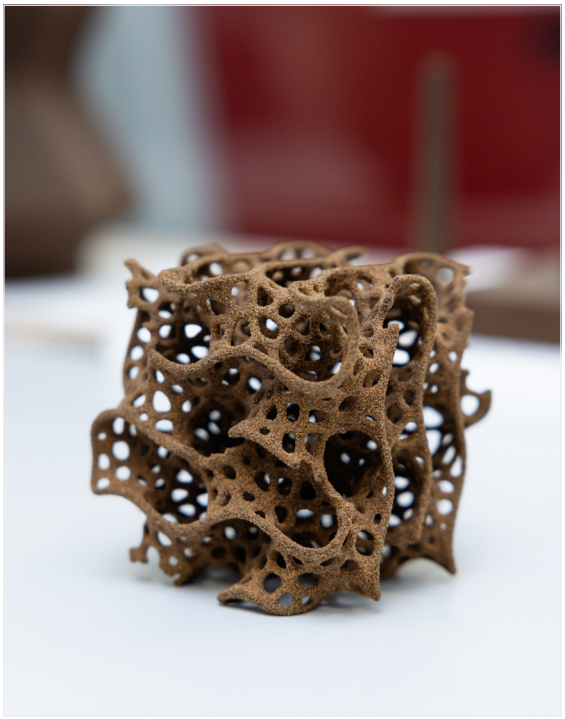
EQUIPMENT FOR THE PRODUCTION OF 3D STRUCTURES FROM POWDER-BASED MIXTURES

FUNCTION AND USE:

Equipment for so-called "additive manufacturing" of 3D structures with defined structure by 3D powder printing, such as plastic models and sand casting cores, enabling 3D printing of complex structures and so-called "scaffolds" for various applications, including porous glasses prepared by recycling industrial waste.

TECHNICAL SPECIFICATION:

- Production area 295 × 195 × 145 mm
- 250 dpi layer resolution, expandable to a minimum of 300 dpi
- Ability to print thin films ≤ 150 µm thick



Model:
Voxeljet AG VX200 3D-Printing System ODB

Responsible person:
Arish Dasan, arish.dasan@tnuni.sk

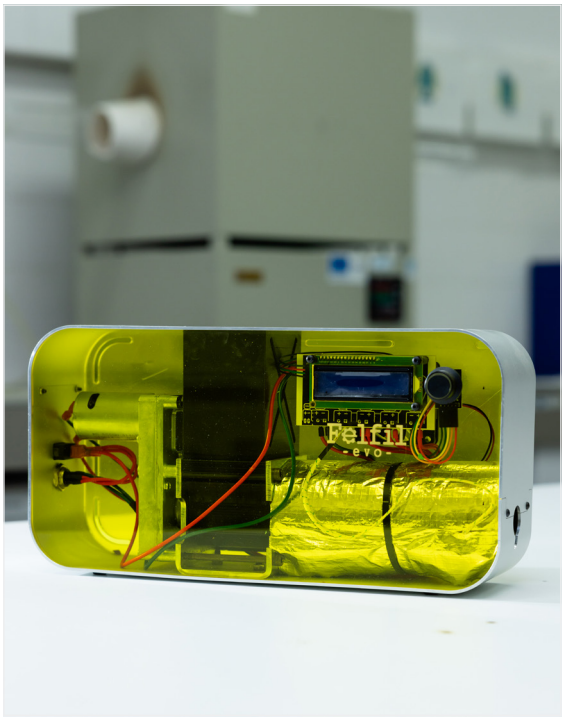
FILAMENT EXTRUDER

FUNCTION AND USE:

Felfil Evo is a safe and easy-to-use plastic filament extruder capable of producing custom and recycled filament for 3D printers using pellets or failed prints. The Felfil Evo Filament Extruder can also produce composite filament by allowing users to mix different materials, including polymers and additives such as ceramic and glass powders, to create customized 3D printing filaments.

TECHNICAL SPECIFICATION:

- Dimensions: 350 mm (W) × 180 mm (H) × 108 mm (D)
- Extrusion rate: 100–150 grams per hour
- Maximum temperature: 250°C (standard), with an option for 300 °C upon request
- Compatible materials: PLA, ABS, HIPS, PETG, PA (Nylon), PVA
- Filament diameter: supports both 1.75 mm and 2.85 mm diameters by changing the nozzle
- Energy consumption: average: 80 W; maximum: 180 W
- Hopper capacity: 1 liter
- Gearmotor speed: adjustable from 0 to 9 RPM



Model:
Felfil Evo

Responsible person:
Mokhtar Mahmoud,
mokhtar.mahmoud@tnuni.sk

Laboratory of surface treatment of glass in semi-operational conditions

This facility focuses on developing advanced coatings and surface modification techniques in semi-industrial scale. The pilot coater is a hybrid technique that includes HC-PECVD (hollow cathode plasma enhanced chemical vapor deposition) and PVD (physical vapor deposition) technologies in the same line. Durable thin films for antireflective, low E, anti-corrosion, and wear resistant applications can be produced using the pilot line.

- **PILOT COATER FOR GLASS SURFACE TREATMENT UNDER SEMI-OPERATING CONDITIONS**

PILOT COATER FOR GLASS SURFACE TREATMENT UNDER SEMI-OPERATING CONDITIONS

FUNCTION AND USE:

This pilot coater replicates industrial glass surface treatment. It is designed for the research, development, and testing of advanced optical coatings on glass substrates in a semi-industrial production scale. This device is semi-automatic and fully programmable recipes that allows researchers and industrial experts to fine-tune the deposition parameters and evaluating coatings performance while ensuring reproducibility and repeatability. The coater integrates hybrid HC-PECVD (hollow cathode plasma enhanced chemical vapor deposition) and PVD (physical vapor deposition) technologies in a same line, allowing to deposit novel multilayers with durable and precise material composition. This coater reduces the risk and cost of full-scale implementation and facilitate scalability studies.

TECHNICAL SPECIFICATION:

- Glass Size: capable of surface treating flat glasses with a maximum size of 300 × 400 mm
- Three magnetron sputtering compartments (two planar and one rotary type, size: 432 × 127 × 10 mm), allow possibility to deposit three different materials in a single process
- One PECVD compartment (120 cm × 80 cm) with dual hollow cathodes
- PECVD precursors: Silane (SiH_4) and TMDSO (1,1,3,3-Tetramethyldisiloxane)
- Gas flow control for PVD: Ar, N_2, O_2 (3 MFCs up to 500 sccm each gas) and for PECVD: Ar, N_2, O_2 (mixed gas up to 2500 sccm, 2 MFCs)
- Plasma sources with adjustable DC and AC power supplies
- Load lock chamber available for faster and continuous sample handling
- Sample thickness range 0.1 mm to 5 mm. Flat sample substrates, including metals, ceramics, and plastics that are vacuum compatible and withstand plasma heat, are possible to use
- Equipped with two primary pumps and five turbomolecular pumps for producing base vacuum (< 1×10^{-6} Torr)
- Programmable deposition recipes and real-time process monitoring
- Mass spectrometer available in the PVD compartment to monitor the gasses ratio
- In-line light transmission sensor to measure the coated glass transmittance

Model:
Designed by GRAUX, Belgium, and Engineered by AGC, Belgium

Responsible person:
Amirhossein Pakseresht,
amir.pakseresht@tnuni.sk

CONTACT INFO

FunGlass – Centre for Functional and Surface Functionalized Glass

Alexander Dubček University of Trenčín
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