The Department of Materials Science, Nanotechnology, and Engineering Physics has eight classrooms used for educational purposes. In addition to the classrooms, the department also has a TV panel (GMK 328 and GMK 320). The nanotechnology and nanomaterials laboratories, GMK 318 and GMK 316, were created under Scientific and Technical Program BR21881939, "Development of Resource-Saving Energy-Generating Technologies for the Mining and Metallurgical Complex and the Creation of an Innovative Engineering Center," with the goal of developing technologies for synthesizing nanomaterials, including semiconductors, polymers, bio- and nanomaterials, and composites.

The Department of Materials Science, Nanotechnology, and Engineering Physics boasts extensive facilities and is equipped with modern laboratory equipment and specialized software, ensuring a high level of educational and research excellence (Table 1, Fig. 1). The department's laboratory infrastructure is based on the Engineering Profile Laboratory (EPL) and the Materials Science and Nanotechnology Laboratory, which meet modern requirements for specialist training and applied and fundamental research.

The department has access to a wide range of high-tech analytical and measurement equipment, including a scanning electron microscope, X-ray diffractometer, atomic force microscope, hardness testers and microhardness testers, a chemical vapor deposition (CVD) system, and specialized Thermo-Calc Software for thermodynamic modeling of phase diagrams and predicting material properties. This equipment enables comprehensive studies of the structure, composition, and properties of materials at the micro- and nanoscale levels.

The Laboratory of Physical Properties of Materials focuses on research and determining the fundamental physical and mechanical properties of metallic materials and alloys. Laboratory work and research include measurements of hardness, microhardness, strength, and deformation characteristics, as well as analysis of the influence of chemical composition and heat treatment on material properties. The obtained results are used to evaluate the performance characteristics of materials and justify their practical applications.

The Nanotechnology and Nanomaterials Laboratory specializes in the development and research of technologies for synthesizing various nanomaterials, including semiconductors, polymers, bio- and nanomaterials, and composites. The laboratory conducts research aimed at controlling the structure and properties of materials at the nanoscale, which forms the basis for creating new functional materials with tailored characteristics. Particular attention is paid to thin-film deposition methods, surface nanostructuring, and the study of their physicochemical properties.

The X-ray diffraction laboratory is designed to study the crystal structure, phase composition, and degree of defects of metallic and non-metallic materials using X-ray diffraction analysis. Using an X-ray diffractometer, phase identification, determination of crystal lattice parameters, texture analysis, and residual stress analysis are performed. These studies are key to understanding the mechanisms of material structure formation and predicting their performance properties.

Table 1 List of equipment used in the educational process

Name of equipment	**The purpose of equipment, devices, and inventory in the educational process**	**Location**
Aperture and specific surface analyzer SSA-7000, Henan, China	Determination of specific surface area and porosity of samples	GMK 130
SD20-Kit laboratory pH meter SevenDirect. Measurement range: -2,000...20,000 pH with selectable resolution of 0.001/0.01/0.1; -2,000.0...2,000.0 mV,	A pH meter is a device for measuring the hydrogen index, a pH indicator that characterizes the activity of hydrogen ions in solutions, water, food products and raw materials, environmental objects, and continuous process control systems.	GMK 318

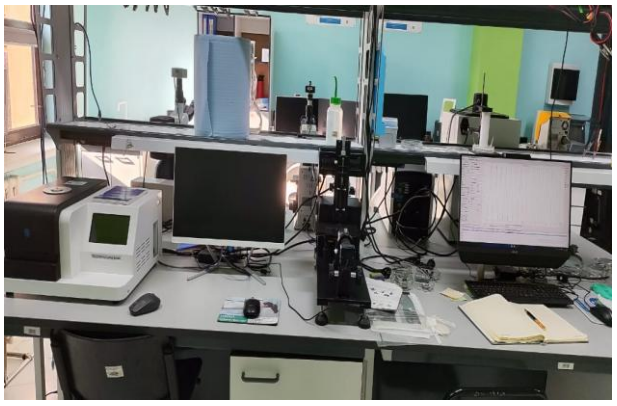
Quattro ESEM, Termo Fisher Scientific, USA	Scanning electron microscopy with energy-dispersive X-ray analysis) determines the elemental composition of the sample surface and its textural characteristics	GMK 149
UV spectrometer	Measurement of absorption (or transmission) of light in the UV and visible spectral range	GMK 316
Bambu Lab X1E Combo EU 3D Printer with AMS System	The Bambu Lab P2S is an updated 3D printer with a larger touchscreen, AI error detection, automatic flow calibration, an active cooling system, and support for multi-material printing via AMS 2 Pro.	GMK 13A
IR spectrometer	Analysis of substances, determination of functional groups	GMK 316
Automatic Specific Surface Area/Pore Size Distribution Measuring Instrument SSA-7000	The SSA-7000 Automatic Analyzer is a high-precision instrument for determining specific surface area (BET method) and pore size distribution using gas physical sorption. Equipped with independent real-time pressure sensors, it measures 680 x 460 x 820 mm, weighs 42.5 kg, and operates on a 220 V power supply, ensuring high accuracy.	GMK 318
EPR spectrometer	Measuring the absorption of microwave energy by unpaired electrons in a magnetic field	GMK 316
Laboratory multimeter Bante 900 UK	Model Bante900P, Range -2.000~20.000pH, Accuracy ±0.002pH, Measurement step 0.1, 0.01, 0.001pH, selectable, Calibration 1...5 points, pH buffer group USA, NIST, DIN or User, Range ±1999.9mV, Accuracy ±0.2mV	GMK 318
Laboratory applicator for applying coating to current collectors MCK-AFA-1	Main technical characteristics and configuration: Maximum label length: 1000 mm; Maximum label width (with backing): 160 mm.	GMK 316
Ion chromatograph CIC 100, SHINE, China	Determination of anions and cations in water	GMK 318
AGB-3B Acrylic Vacuum Glove Box (size 800x550x600mm, acrylic material, 6mm thickness, hallway level, vacuum 0.1 MPa)	• Material: Acrylic (organic) glass PMMA • Material thickness: 6 mm. Main chamber dimensions (L x W x H): 800 x 550 x 600 mm. Loading airlock dimensions (L x W x H): 240 x 240 x 240 mm. Airlock type: Vacuum. Vacuum level in the airlock: up to -0.1 MPa. Atmosphere creation in the main chamber: By pumping an inert gas (e.g., nitrogen or argon).	GMK 316
High-pressure microreactor RP 250	Modification of a sample at high pressure and temperature	GMK 318
Muffle furnace 7.2l	Benchtop laboratory equipment for heat treatment at temperatures of 900–1300°C. It features a ceramic chamber, a PID controller, heaters on all four sides, and consumes 2.5–5 kW at 220V.	GMK 318
Microwave Digestion System YMW-HP 80, LabSoul, China	Microwave reactor Microwave Digestion System YMW-HP 80, LabSoul, China. Modification of the sample at high pressure and temperature and the influence of microwave irradiation.	GMK 318
CVD CNT growing system	The system for the synthesis of carbon nanotubes (CNTs) using the Chemical Vapor Deposition method is designed to produce single- and multi-walled nanotubes from gaseous hydrocarbons at high temperature in the presence of a metal catalyst.	GMK 326

MG-HSJS100 Electric Heated Vertical Double Roller Machine	Design: Vertical arrangement of two rollers. Drive: Electric (each roller can have an independent drive). Heating system: Electric heating (heating elements or induction), often with individual control for each roller. Roller adjustment: Adjustment of the gap between the rollers, often hydraulic or electric. Heating power: Can vary from a few kW to hundreds of kW depending on size (e.g., 147 kW - Made-in-China.com).	GMK 316
Four-point probe resistance meter (10 MOhm-100 MOhm) (OSSILA)	Measuring the resistance of grounding elements using a three- or four-wire method; Measuring the resistance of metal connections (metal bonds) with a current of over 200 mA at a resistance of 1 mOhm (resolution 1 mOhm); Measuring alternating current with a frequency of 50 Hz; Determining the continuity of protective conductors; Calculating the specific soil resistance in Ohm/m;	GMK 316
Analytical balance Kern ADJ 200-4, maximum capacity 200 g, readability 0.1 mg, repeatability 0.2 mg, linearity = 0.4 mg	High-precision analytical balances with internal calibration, designed for laboratory measurements with microgram accuracy.	GMK 330
ViscoQS 100-L Kit Including ViscoQC 100-L Rotational Viscometer	A kit including the ViscoQC 100-L rotational viscometer, designed for fast and accurate measurement of liquid viscosity in laboratory and industrial settings.	GMK 330
HelioVolt Joule Heating System Base Model B+ (400-2800C)	A compact system for ultra-fast Joule heating of powders and materials. Provides instant heating to 2800°C and equally rapid cooling. Suitable for nanomaterials, heat treatment, powder synthesis, and modification.	GMK 330
Nova 600 kit including Nova 600 specific surface area analyzer and degassing accessory	A laboratory kit for analyzing the specific surface area and porosity of materials using the adsorption technique (BET). It consists of the analyzer itself and an accessory for preliminary degassing of samples.	GMK 330

The equipment used in training enables applicants to find employment in their field upon completion of their studies and integrate into the engineering environment. In addition to the educational process, the equipment is used for grant and contractual projects, which involve the most interested applicants on a paid basis during their free time.

Analytical scales Kern ADJ 200-4

Ultrasonic Homogenizer JY92-IIN



SKZ 1052 differential scanning calorimeter

ES-II electrospinning laboratory unit

CVD CNT growing system

Laser Particle Size Analyzer Winner 2005A

Fig. 1 – Material and technical base of the department