

FACULTY OF CHEMICAL TECHNOLOGY

Information on the selected test equipment at the Faculty of Chemical Technology, Poznan University of Technology

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The Faculty of Chemical Technology at the Poznan University of Technology is a leading provider of science education in Poland, undertaking diverse studies, research and development and educational activities. Priority responsibilities of the Faculty include collaborating with entities engaged in economic activity, including joint research projects for implementing newly developed technologies, conventional designs of technologies and chemical analyses stemming directly from industrial demand. The research infrastructure of the Faculty of Chemical Technology facilitates partnerships with the industry in virtually every aspect. This catalog contains samples of equipment used in research and industrial practice. I cordially invite you to work with us.

Professor Krzysztof Alejski, DSc Eng. Dean of the Faculty of Chemical Technology

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Spectrophotometer

UV-Vis JASCO V-750

TECHNICAL SPECIFICATIONS:

- double beam apparatus equipped with a deuterium lamp and halogen, and with a grating monochromator, as well as a variable slit with an adjustable voltage photomultiplier
- range apparatus operation: 190-900 nm;
 controlled spectral width in the range of
 0.1 to 10 nm; wavelength accuracy: 0,2 nm
- · scan rate: 10-8000 nm/min
- possibility of connecting a thermostatic chamber capable of working in the range of from -10 °C to 110 °C
- Spectra Manager II software



KEYWORDS

- UV-Vis spectroscopy
- absorbance and/or transmittance

APPLICATION:

 quantitative analysis, qualitative analysis and kinetic analysis on the basis of spectrophotometric measurements of selected organic and inorganic compounds, environmentalpollution or enzymatic processe



Elemental analyzer

(C, H, N, S)

TECHNICAL SPECIFICATIONS:

- operating modes: CHNS, CHN, CNS, CN, N, S as standard with TCD, S, O, CI with IR detection optional
- detection ranges: C: 0.004-40 mg, H: 0.002-3 mg,
 N: 0.001-15 mg, S: 0.005-6 mg;ss additional option:
 O: 0-2 mg, CI: 0-2 mg (the absolute value of elements)
- sample weight: from 0,02 mg to approx. 1 g
 (depending on sample type and analytical conditions)
- sample feeder: of 80-position carousel, solid samples in tin boats and liquid samples in capsules
- gases used and their consumption: He: 99.995% purity
 3 I/analysis (alternatively Argon)
- O2: 99.995% purity 0.05 l/analysis

APPLICATION:

 the possibility to perform CHNS, CHNS + O and CHNS + Cl analysis

- elemental analysis
- percentage contentC, H, N, S, indirectly O i Cl

ASAP 2020

Accelerated Surface Area and Porosimetry System

TECHNICAL SPECIFICATIONS:

- · range of pore diameter: 3.5-2000 nm
- pressure measurement: 0 to 950 mmHg
- degas system: 2 ports, ambient to 450 °C,
 1 °C increments
- measurement conditions: 1 port, liquid nitrogen (-196 °C)
- adsorptive gases: nitrogen, carbondioxide, argon, krypton



APPLICATION:

- determination of specific surface area (BET)
- determination of sorption isotherms of microand mesoporous samples
- determination of porosity of powder materials
- chemisorption research

- · BET surface area
- · diameter and volume of pores
- adsorption/desorption isotherms
- chemisorption

Thermal analyzer

TG/DTA/DSC STA 449

TECHNICAL SPECIFICATIONS:

vacuum control:10⁻² mbar

temperature range: 0-1550 °C

aircooling

· gases used: nitrogen, air

· electromagnetic weight of the load compensation

measuring range of the sample mass: 0-35 g

the rate of heating/cooling in the range of 0.01-50 K/min

two sample carriers: TG-DSC i TG-DTA

APPLICATION:

- thermalstabilitycharacteristics
- measurement of phase transitions and polymorphic
- determine the effects of exothermic and endothermic (enthalpy)of organic and inorganic materials



- thermal analysis TG/DTA/DSC
- · endothermic and exothermic effects
- phasetransitions and polymorphic

FTIR

spectrophotometer



TECHNICAL SPECIFICATIONS:

- spectral range: standard:
 MIR 8000to 350 cm⁻¹
- scan speed: up to 65 mm/ sec
- spectral resolution: better than 0.4 cm⁻¹
- the horizontal transmission attachment
- to in situ photopolimerization
- ATR and DRIFT attachment

APPLICATION:

- performing of FTIR spectra in transmission and reflectance (ATR) mode
- · the possibility of kinetic measurments
- qualitative analysis

- FTIR spectra
- transmission and reflectance (ATR) mode
- · kinetics reaction
- · qualitative analysis

APPLICATION:

- measuring the surface and interfacial tension
- · analysis of the wettability of solid
- · measuring the density of solid substances
- the sedimentation speed of dispersions
- penetration resistance of a sediment
- critical micelle concentration (CMC) of surfactants
- contact angle and surface free energy of solids, powders or fiber bundles

TECHNICAL SPECIFICATIONS:

- measuring range of surface and interfacial tension
 1 1000 mN/m
- measuring range of density 0.001 2.3 g/cm³
- resolution of the surface and interfacial tension 0.001 mN/m, density 0.001 g/cm³
- other specifications:
- maximum load: 210 g
- resolution of distance 0,1 μ m
- travel speed: 0.09 ... 500 mm/min.
- resolution of the temperature: 0.01 °C
- built-in and software-controlled ionizer
- du Noüy ring with resolution0.001 mN/m
- automatic measurements of surface and interfacial tension

Force Tensiometer

- K100



- · density
- wettability
- sedimentation
- surface and interfacial tension

Mastersizer 2000

particle sizeanalyzer

TECHNICAL SPECIFICATIONS:

- measurement range (diameter range):
 200 nm 2 mm
- dynamic light scattering method utilizing two laser beam: red (632 nm) and blue (470 nm)
- dynamic measurement with the use of wet (Hydro 2000 G) or dry (Scirocco 2000) equipment
- compressor
- vacuum device to collect the powders after dry-method measurements



APPLICATION:

 particle size measurements (powder inorganic and/ or organic materials, pharmaceuticals) and evaluation of their tendency to form agglomerates structure based on dynamic light scattering method

- particle size
- homogeneity
- · polidyspersity
- agglomerates and aggregates

APPLICATION:

- measurement of particle size distributions utilizing non-invasive back scattering method (NIBS) in the range of nano
 - and micrometer (0.6-6000 nm)
- determining of zeta potential (electrophoretic mobility) and electrokinetic curves
- determining of molecular weight of biological and polymer materials



Zetasizer Nano ZS equipped with MPT-2 autotitrator

TECHNICAL SPECIFICATIONS:

- · range of particle size distributions: 0.6-6000 nm
- measurement principle: NIBS (noninvasiveback scattering method)
- measurement of particle size distributions using polystyrene or quartz cuvettes with different capacity
- automated autotitrator with integrated magnetic stirrer, pH probe, dosing pump, the ability to dosing three different titrants in a single measurement cycle
- measurement of the electrophoretic mobility (zeta potential) in a desktop or appointment electrokinetic curves using autotitrator
- range of molecular weight measurement:980
 Da 20 MDa

- · zeta potential
- · electrokinetic mobility
- particle size distribution
- nanomaterials
- · molecular weight

QVF MiniPlant Pilot-Tec

reactor

TECHNICAL SPECIFICATIONS:

- · capacity: 10 L
- heating jacket with a proper connection to water bath
- T50 IKA Werke GmbH high speed stirrer (up to 2000 rpm)
- · elements dosing solutions into the reactor
- reflux condenser
- · drain valve at the bottom of the reactor



KEYWORDS

- · precipitation of powders materials
- oxide materials
- inorganic pigments
- · water and/or emulsion media
- · semi-technical scale

APPLICATION:

- synthesis of silicas and/or silicates characterized with high degree of dispersion in semi-technical scale using polar or nonpolar media
- precipitation of simple oxides and multicomponent oxide-based materials
- production of nanometric-sized materials in in semi-technical scale using polar or nonpolar media

Bioreactor

Biostat Bplus

TECHNICAL SPECIFICATIONS:

- working volume: 0.6 2 l
- process control: temperature, pH, dissolved oxygen, flow rate, stirrer speed, turbidity, foam level control, liquid level control
- · rotameter to control the air flow
- 4 fast load peristaltic pumps

APPLICATION:

- biodegradation of petroleum-derived compounds
- fermentation processes
- · biosurfactants production



- fermentation
- · bioreactor with mixing



Mini Spray Dryer

B-290 Advanced



TECHNICAL SPECIFICATIONS:

airflow: 35 m³/h

maximum temperature input: 220 °C

spray gas: compressed airor nitrogen; 200-800 l/h, 5-8 bar

possible particle diameter range: 1-25 μm

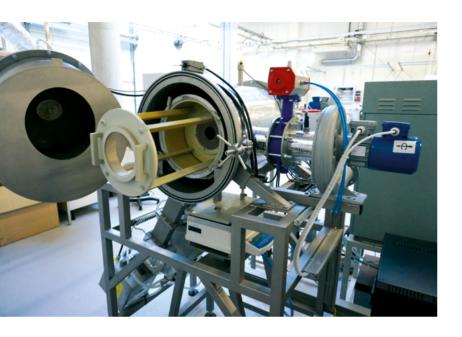
glass assembly: 3.3 borosilicate

 evaporating capacity: 1.0 l/h for water, higher for organic solutions

APPLICATION:

- drying of various nanomaterials (inorganic oxides) from water and organic solutions
- · drying of pharmaceuticals
- drying of natural materials (dyes) and biopolymers (lignin, cellulose, chitin, chitosan etc.)
- encapsulation of various chemical substances

- spray drying
- · encapsulation
- · nanomaterials



APPLICATION:

- analysis of drying of the biological materials, food products, polymers and wood, with the use of convective and microwave technique (separately as well as in different combination

 hybrid processes), with the possibility of application of power ultrasound to enhance the drying operation
- validation of the mathematical models of drying

Rotary hybrid dryer

TECHNICAL SPECIFICATIONS:

- microwave power 100-2000 W
- ultrasound power 10-200 W
- batch weight 100-2000 g
- automatic acquisition of the key process parameters (temperature and mass of sample, the drying medium parameters, energy consumption etc.)

- drying
- microwaves
- ultrasound
- biomaterials
- construction materials
- modeling

Blow film extrusion

GF-25L/500-WS



TECHNICAL SPECIFICATIONS:

Blow film extrusion line consisting of a single screw extruder with a screw diameter of 30 mm and the L/D ratio = 28. The die of the rotation mechanism (stabilization of the thickness of the film tube) having a diameter of 70 mm and cartridge of 30 mm. Universal die design allows changeover the system for film extrusion from PE-LD and PE-MD. The line also has a non-contact controlling the width of the blow film.

KEYWORDS

- · blow film extrusion
- · film

APPLICATION:

 Technological extrusion line designed forpolyolefines blow film production (PE-LD, PE-MD, PE-HD, PP).
 Be used in a barrier screw also allows the processing of recycled materials.

Cast film

extrusion

APPLICATION:

- technological extrusion line designed for cast film production (oriented in mechanical direction)
- the possibility of cast film extrusion from a small amount of raw material- about 1 kg



TECHNICAL SPECIFICATIONS:

- cast film extrusion line consisting of a single screw extruder with a cylinder diameter of 30 mm and the L/D ratio = 24
- slit die with the width of slot equals to 1 mm and the length of slot equals 120 mm
- film dimensionally stabilized by means of an air knife and a chill roll (chill roll temperature control by a thermostat)

- extruder
- extrusion
- · cast films
- · oriented films

Universal tensile machine

Zwick Roell Z020

TECHNICAL SPECIFICATIONS:

universal tensile machine with temperature chamber (range of tests from -80 to +250 $^{\circ}$ C) and a video extensometer, with a maximum range of load of 20 kN

Equipment:

- · head 20 kN
- · head of 100 N
- screws wedge grips 30 kN
- handles pneumatic low range forces (film sample)
- · adapter for 3-point bending, compression and crushing test
- adapter for testing the coefficient of static friction and dynamic (ISO 8295)
- adapter for testing the break through of films (DIN EN 14477)



KEYWORDS

- · tensile machine
- temperature chamber
- · extensometer
- bending
- stretching
- break through
- · coefficient of friction

APPLICATION:

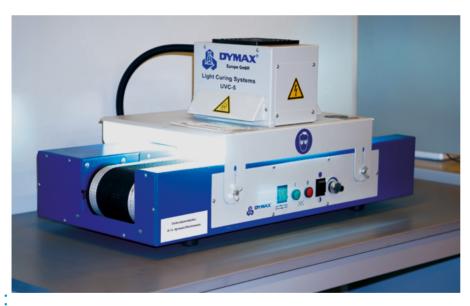
 Universal tensile machine for evaluation mechanical properties in static and dynamic tests using the temperature chamber. Suitable starters also allow to carry out research on the properties of films (strength, break through, coefficient of friction).

UVC-5 UV

Light-Curing Conveyor

APPLICATION:

The Dymax UVC-5 Conveyor is designed for curing UV/Visible light-curable adhesives, coatings, and inks in a variety of different industries (electronic, medical, optical, aerospace, automotive). This system is ideal for curing smaller parts and can cure materials applied to a variety of substrates including paper, plastic, metal, glass, laminated materials, printed circuit boards, and many others.



TECHNICAL SPECIFICATIONS:

- lamp power: 850 W
- intensity: 800 mW/cm²
 (typical value of new bulb at 10-mm distance)
- dimensions (W x L x H):
 330 x 700 x 280 mm
- belt material Teflon®
- belt width 120 mm
- belt speed adjustable from 0,1 - 10 m/min

KEYWORDS

Conveyor System

Injection molding machnine



350 kN

TECHNICAL SPECIFICATIONS:

Hydraulic injection molding machine with a closing force equal to 350kN with plasticizing system adapted to processing thermoplastics and composites. A screw diameter of 25 mm, L/D = 15, a specific injection pressure 1575 bar, injection volume computing 49 cm³. The injection nozzle closed with a needle; the injection unit in the embodiment with improved abrasion resistance.

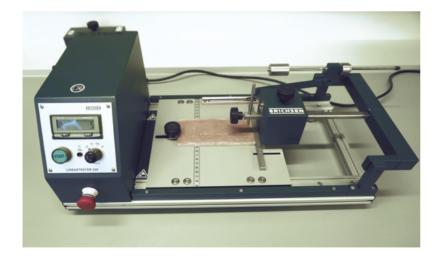
APPLICATION:

• Injection molding machine including a dual-socket mold with removable inserts fits any research (according to the requirements of PN-EN ISO 294-2:2002). A 2-slot injection mold allows for testing the characteristics of tensile strength (PN-EN ISO 527-2 - dumbbell shape type 1A), bending and Charpy impact strength (ISO 179-1) and flammability of plastics (UL 94 test as per EN 60695-11-10-1999 – bar shape with thickness of 3 mm). Having injection unit with improved abrasion resistance also allows the processing of composite materials.

- injection molding machine
- · injection
- · injection mold

TECHNICAL SPECIFICATIONS:

- scratch force range: 0.5 40 N (increment 0.5 N, accuracy 0.2 N)
- test speed:fixed 25/35/200 mm/s or programmablein the range 20 – 200 mm/sby using the external control
- test distance: 60 mm
- test tip: ISO ($\emptyset = 1 \text{ mm}$), IHD ($\emptyset = 0.6 \text{ mm}$)
- specimen dimensions: min. 150 x 10 mm, max.
 150 x 210 mm
- additional equipment:
 - microscopeMotic SMZ-143 with a camera CCD
 - computer with a software Motic Images Plus 2.0



Scratch Hardness Tester Lineartester 249

APPLICATION:

- determination of scratch resistance of protective surface coatings, such as paint and lacquer finishes, plastic coatings etc. in accordance with standards EN, EN ISO, ISO
- the possibility of cycletests
- determination of scratch hardness of materials

- scratch resistance
- scratch hardness

Thermoforming

TECHNICAL SPECIFICATIONS:

Thermoforming type 1210
 for forming positive with a stroke
 of the table 115 mm, size plates:
 228 x 305 mm, a maximum of
 thermoformed element:
 204 x 280 mm and maximum
 panel thickness - 6 mm



APPLICATION:

 The Thermoforming 1210 will produce professional, quality and high definition vacuum formings on a smaller scale as required by model makers and development engineers. The device embodies features of the design, production technique and properties of the material used. Perfect device for testing technology.

KEYWORDS

thermoforming

Set of rheometers:

Rotational rheometer PHYSICA MCR 301 Rotational rheometer PHYSICA MCR 501

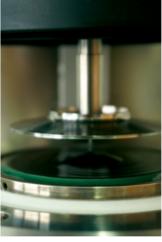
TECHNICAL SPECIFICATIONS:

- The Physica MCR 301 rotational rheometer is used to evaluate the rheological properties of polymeric materials with following systems: cone-plate, parallel plate; to evaluate extensional viscosity, to DMTA – torsion system; to photopolymerization (UV system). The temperature control system in the range from –130 to 450°C.
- The Physica MCR 501 rotational rheometer is equipped with measuring systems:concentric cylinders, cone-plate, parallel plateandimpellers. The temperature control system in the range from –40 to 200°C. The ability to perform measurements in the steady and oscillatory flows. It can work with various attachments to measure the rheological properties of surface layers (IRS, Interfacial Rheology System), birefringenceanddichroisminflow (DORA, Dynamic Optical Rheo Analyzer), small angel light scattering (SALS, Small AngelLight Scattering System) andoptical microscope.



• The set of rheometers allows to determine the rheological characteristics of a variety of materials, including: flow curves, viscosity curves, first normal stress difference (N1), course of the storage modulus G'and loss modulus G" as a function of the amplitude and frequency oscillation, dynamic analysis of materials in the solid state (DMTA) andobtaining an information about the change of internal structure of fluid in the flow (DORA and SALS systems).





- rheology
- flow curve
- · viscosity curve
- extensional viscosity
- DMTA
- mechanical spectra

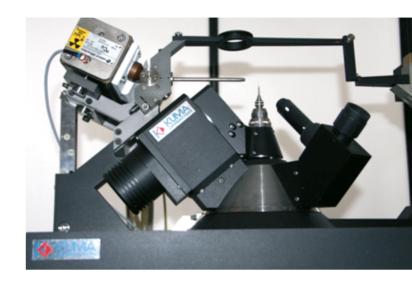
X-ray diffractometer

TECHNICAL SPECIFICATIONS:

- X-ray radiation Cu Kα, measurement range of 2-80° (2θ)
- high voltage generator: max: 40 kV, max 30 mA
- · detectors:
 - traditional proportional detector
 - CCD detector
 - software for the data
 collection and interpretation
 diffractograms

KEYWORDS

- wide angle X-ray scattering (WAXS)
- · supermolecular structure
- identification and qualitative analysis of semicrystalline compounds
- crystalline and polymorphism
- · phase transitions



APPLICATION:

- identification and qualitative analysis of semicrystalline polymers, small-molecule compounds, minerals, metals and alloys
- analysis of supermolecular structure in plastics, polymer blends, and composite materials
- investigation of polymorphic structure and crystallite size
- investigation of texture and molecular orientation
- analysis of phase transition in polymers and smallmolecule compounds

Test apparatus

for fractionation processes

TECHNICAL SPECIFICATIONS:

- · column diameter 80 mm
- tray column 16 bubble cap trays
- column packing bed height of 2 m
- boiler capacity 50 l
- heating power 10 kW
- · operating pressure 0.2 to 1.0 bar

APPLICATION:

Installation for studies of fractionation processes
 (distillation, rectification) in a batch or continuous setup,
 containing a replaceable tray or packed column, an
 arrangement of tanks and pumps, vacuum pump and
 a set of measuring instruments. There is a possibility
 of sampling each column tray, and monitoring of the
 distribution of pressure and temperature along the
 column.



- fractionation
- · distillation
- · rectification
- column vacuum



Pegasus® 4D GCxGC-TOFMS

Comprehensive Two-Dimensional Gas Chromatography with Time-of-Flight Mass Spectrometer



TECHNICAL SPECIFICATIONS:

- one-dimensional gas chromatography (1D GC)
- comprehensive two-dimensional gas chromatography
 (2D GC, GCxGC)
- Time-of-Flight Mass Spectrometry(TOF-MS) with spectral collection rates up to 500 full-range mass spectra/second (500 Hz)
- flame Ionization detector mode
- chromatograms and mass spectra data processing (with the spectral deconvolution)

APPLICATION:

- qualitative and quantitative analysis of the volatile (VOCs) and semi-volatile organic compounds (SVOCs) in complex matrixes, e.g. pollutants, pesticides, fuels, PAH, aromas
- automatic and manual preparation of liquid (e.g. drink water, waste-waters) or solid (e.g. soil, sediments) samples for chromatographic analysis, using methods like static head-space (HS), solid phase extraction (SPE), solid phase microextraction (SPME), stir bar sorptive extraction (SBSE), liquid-liquid microextraction (LLME)

- · gas chromatography
- comprehensive two-dimensional gas chromatography
- Time-of-Flight mass spectrometry
- pesticides
- fuels
- · aromas
- environmental pollution



The 4000 QTRAP LC-MS/MS system

TECHNICAL SPECIFICATIONS:

Tandem mass spectrometry coupled witha liquid chromatograph is equipped with: an atmospheric-pressure ionization source ESI (Electrospray) and APCI (Atmospheric Pressure Chemical Ionization), a collision chamber (CID) which allows for operating in the MSnregime and a hybrid mass analyzer - triple quadrupole connected to a linear ion trap. The linear ion trap is the third quadrupole (mass analyzer).

APPLICATION:

- identification of chemical compounds and mixtures
- determination of the structure of chemical compounds(observation of fragmentation processes)
- determination of the isotopic composition of analyzed substances, which allows for the detection of their origin
- "online" identification and quantification of substances separated by chromatographic techniques
- precise determination of the composition of complex mixtures of compounds with high molar masses in proteomics, research materials and polymer Chemistry application

- tandem mass spectrometry
- ultrafast high performance liquid chromatography combined with tandem mass spectrometry
- electrospray ionisation
 (ES UHPLC MS / MS)

Optical emission spectrometer with inductively coupled plasma IRIS/AP



TECHNICAL SPECIFICATIONS:

The spectrometer IRIS is equipped with the axially mounted plasma torch, an Echelle type optical system and semiconductor detector (CID; Charge Injection Device). The apparatus is used for simultaneous multi-element measurements of analytical signals.

KEYWORDS

- optical emission spectrometry
- inductively coupled plasma
- · elements determination

APPLICATION:

 simultaneous determination of elements at trace level in various types of samples

Atomic absorption spectrometer HR CS contrAA 700 with continuum source of radiation

TECHNICAL SPECIFICATIONS:

Atomic absorption spectrometer
HR CS contrAA 700 with continuum source
of radiation – xenon short arc lamp
(Analytik Jena AG, Niemcy).The apparatus
is equipped with flame atomizer and graphite
furnace atomizer (graphite tube) as well
as vapour generation system.

APPLICATION:

 sequential determination of trace elements in different samples (solid and liquid) also with vapour generation technique



- atomic absorption spectrometry
- · vapour generation
- trace analysis
- determination of elements

Dispersive Raman

Microscope DXR

APPLICATION:

- characterization of wide range of materials with different structure, giving a finger-print of the compounds with complex structure
- complementary with IR and FTIR techniques
- qualitive research
 of compounds on molecular
 level and at monolayers
 of material surfaces
- determination of electrical properties of highly defected materials



TECHNICAL SPECIFICATIONS:

- digital camera with an extended optics Olympus® system, supplied with 4x, 10x and 50x lens
- correction of fluorescence from the user at instrument level
- equipped with a set for kinetic research
- wide range of lasers lengths (532 nm, 622 nm, 780 nm) allows the examination of materials of different origin and various properties
- aperture of 25 μ m and 50 μ m for surface and confocal measurements
- equipped with option for in-situ electrochemical investigation by coupling to the SP-200 potentiostat, BioLogic, France

- · raman spectroscopy
- in-situ electrochemical measurements
- defect degree estimation

TECHNICAL SPECIFICATIONS:

- circulating Argon atmosphere
- moisture below 2 ppm H₂O
- oxygen below 2 ppm O₂
- inert gas purification system allowing the removal of solvent vapor and ionic liquids
- work in the slightly overpressured chamber
- working temperature is approximate to ambient temperature
- ability to perform electrochemical measurements inside the chamber

Glove-box (inert gas wroking chamber)

mBraun





APPLICATION:

- ability to work in an inert atmosphere (for the research sensitive to water and oxygen)
- measurement requiring non-aqueous and non-oxygen atmosphere

- · inert atmosphere
- glove-box

Multichannel potentionstat/galvanostat

VMP 3 BioLogic®



TECHNICAL SPECIFICATIONS:

- the newest generation equipment with highest accuracy within low (pA) and high currents (up to 40 A)
- includes 60 independent modules for electrochemical measurements
- each module contains three potentiometers which allow measurements in two and three electrode configurations
- allows to conduct potentiostatic, potentiodynamic, galvanostatic and electrochemical impedance spectroscopy measurements in wide frequency range
- fully automated measuring process, equipped with user error control
- ability to work in bi-potentiostatic mode

KEYWORDS

- chemical power sources
- energy storage
- electrochemical
 /electrotechnical
 characteristics

APPLICATION:

- detailed electrochemical analysis of power sources
 (button, cylindrical, prismatic, pouch cells and batteries)
- examination of electrochemical sensors or corrosion phenomena
- electrocatalysis

Optical goniometer Data Physics OCA 15



TECHNICAL SPECIFICATIONS:

- apparatus equipped with double dosing system (electronic syringe)
- electronic control which guarantees ease of measurements conduction and reproducibility of the results
- dosing of liquid directly from the syringe do not require any hoses which speeds the preparation period up
- optical system with 6x zoom and LED lightning system with continuous intensity regulation
- contact angle determination: 0 180° with ±0,1° accuracy
- surface free energy determination:
 0,01 2000 mN/m with 0,01 mN/m accuracy

APPLICATION:

this equipment allows the following measurements to be conducted:

- static and dynamic contact angle
- surface free energy SFE
- interfacial tension IFT
- viscoelastic properties (storage and loss modulus)
- adsorption velocity
- work of adhesion
- surface roughness

- surface tension
- contact angle
- · adsorption velocity
- surface roughness

Electrochemical Quartz

Crystal Microbalance (EQCM)



TECHNICAL SPECIFICATIONS:

- quartz crystal microbalance with the highest possible sensitivity and the highest load of resonator (5 MHz)
- gold, stainless steel and glossy carbon electrodes prepared to studied different electrolytes
- points collected with the frequency of 100 ms
- frequency range: 200 kHz
- range of measured resistivity: up to 80 Ohm
- accuracy of mass change: 1 ng
- possibility (special sealed system) to proceed the measurements in aprotic medium (ionic liquids, organic solvents)

 quartz crystal microbalance

KEYWORDS

- · corossion
- electrodeposition

APPLICATION:

- the quantitative analysis of mass exchange processes at electrode/electrolyte interface
- determination of mass change at applied/studied electrode during electrochemical analysis
- determination of resistivity change during electrochemical analysis
- assignation of corrosion kinetics of the applied electrode during electrochemical processes of heat and mass exchange
- determination of deposited compounds on the electrode during electrolysis process

Scanning

Electron Microscope

TECHNICAL SPECIFICATIONS:

- cathode: tungsten wire as source of primary electron beam
- acceleration voltage: 0,3 to 30 kV.
- magnification: 5 to 300000x (quality of image at the maximum value strongly depends on many various factors)
- resolution: 3.0 nm for secondary electron image
 (30 kV acceleration voltage, in high vacuum
 mode); 10 nm for secondary electron image (3 kV
 acceleration voltage, in high vacuum mode); 4.0 nm
 for backscattered electron image (30 kV acceleration
 voltage, in low vacuum mode)
- maximum sample height: 50 mm

APPLICATION:

- Scanning Electron Microscope: type S-3400N; produced by Hitachi in 2009 (Japan). The SEM instrument is typically used for solid state samples surface observations.
 Surface of non-conductive samples before analysis can be coated with carbon material for better image quality by Cressington Carbon Coater.
- The Thermo Scientific NSS spectral imaging systems (coupled with SEM) can be used for elemental analysis of samples (both qualitative and quantitative) with using Energy Dispersive X-ray Spectrometry technique (EDS)



- · SEM
- surface morphology
- EDS
- elemental qualitative analysis

Contact

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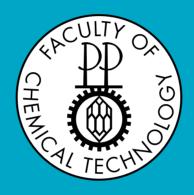
Tester Lineartester 249 inductively coupled plasma IRIS/AP Maciej Andrzejewski, PhD Eng. Mariusz Ślachciński, DSc Eng. +48 61 665 36 37 +48 61 665 2005 maciei.andrzeiewski@put.poznan.pl mariusz.slachcinski@put.poznan.pl Prof. Ewa Andrzejewska, DSc Eng. +48 61 665 36 37 Atomic absorption spectrometer 31 ewa.andrzejewska@put.poznan.pl HR CS contrAA 700 with continuum source of radiation Agnieszka Marcinkowska PhD Eng. Magdalena Krawczyk-Coda, PhD Eng. +48 61 665 36 05 +48 61 665 2283 agnieszka.marcinkowska@put.poznan.pl magdalena.krawczyk@put.poznan.pl 24 **Thermoforming** Paulina Jakubowska, PhD Eng. 32 Dispersive Raman Microscope DXR +48 61 665 3784, 3673 Prof. Elżbieta Frąckowiak, DSc paulina.jakubowska@put.poznan.pl +48 61 665 3632 elzbieta.frackowiak@put.poznan.pl 25 Set of rheometers: Krzysztof Fic, PhD Eng. Rotational rheometer PHYSICA MCR 301 +48 61 665 3238 Rotational rheometer PHYSICA MCR 501 krzysztof.fic@put.poznan.pl Jacek Różański, DSc Eng. +48 61 665 2147 Glove-box (inert gas 33 jacek.rozanski@put.poznan.pl wroking chamber) mBraun Prof. Elżbieta Frackowiak, DSc Arkadiusz Kloziński, PhD Eng. +48 61 665 3632 +48 61 665 3784, 3673 elzbieta.frackowiak@put.poznan.pl arkadiusz.klozinski@put.poznan.pl Multichannel potentionstat/galvanostat 34 VMP 3 BioLogic® 26 X-ray diffractometer Prof. Elżbieta Frąckowiak, DSc Sławomir Borysiak, DSc Eng. +48 61 665 3632 +48 61 665 3549 elzbieta.frackowiak@put.poznan.pl slawomir.borysiak@put.poznan.pl Prof. François Béguin 27 Test apparatus francois.beguin@put.poznan.pl for fractionation processes Prof. Krzysztof Alejski, DSc Eng. +48 61 665 37 19, 3718, 2351 35 Optical goniometer krzysztof.alejski@put.poznan.pl Data Physics OCA 15 Prof. Elżbieta Frackowiak, DSc Pegasus® 4D GCxGC-TOFMS 28 +48 61 665 3632 Ewa Kaczorek, DSc Eng. elzbieta.frackowiak@put.poznan.pl +48 61 665 3688 ewa.kaczorek@put.poznan.pl Krzysztof Fic, PhD Eng. +48 61 665 3238 Jacek Staniewski, PhD Eng. krzysztof.fic@put.poznan.pl +48 61 665 3771 jacek.staniewski@put.poznan.pl **37** Scanning Electron Microscope Piotr Krawczyk, DSc The 4000 QTRAP LC-MS/MS system 29 piotr.krawczyk@put.poznan.pl Joanna Zembrzuska, PhD Eng. +48 61 665 3659, 3655 +48 61 665 2015 joanna.zembrzuska@put.poznan.pl

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Optical emission spectrometer with

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Scratch Hardness



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