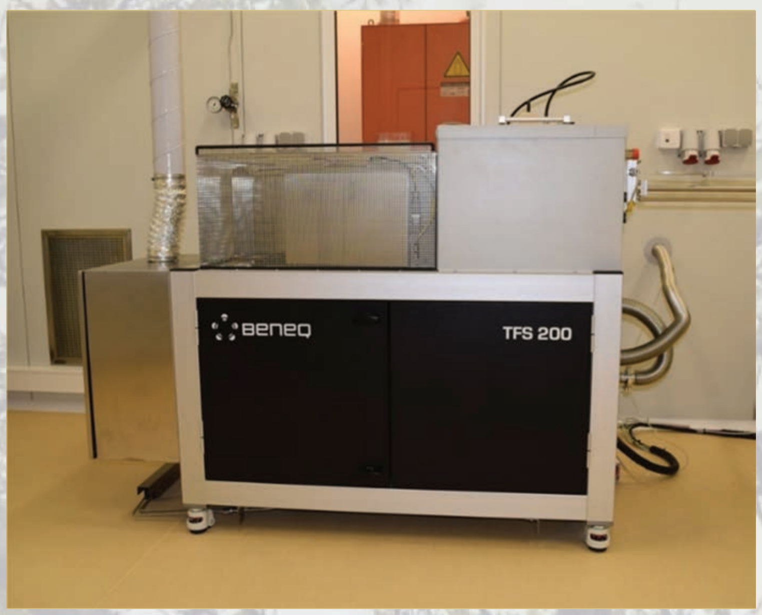
REGPOT-2012-2013-1 NMP
shttp://www.inera.org

Plasma Enhanced Atomic Layer Deposition BENEQ TFS-200

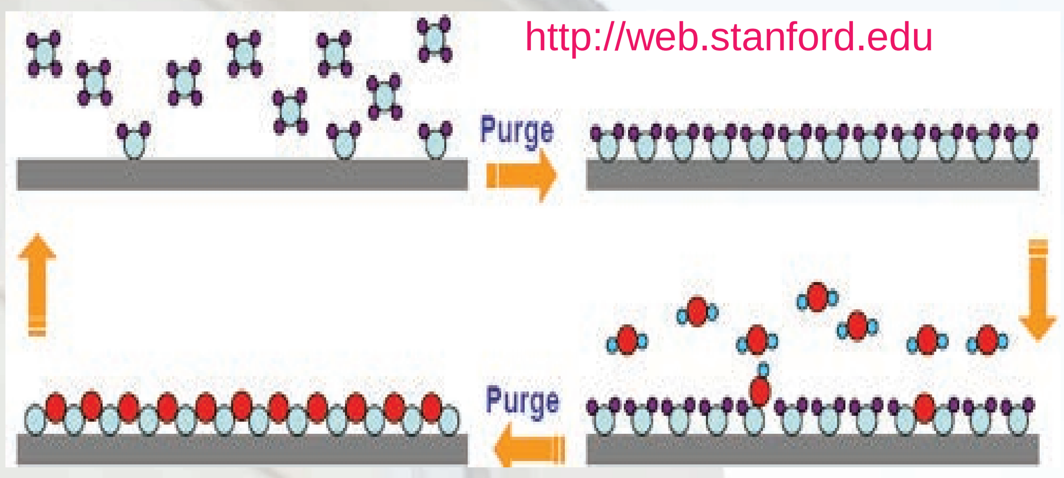
D.Z. Dimitrov[1], V.B. Mehandzhiev[2], B.S. Blagoev[3], J. Leclercq[4], P.K. Sveshtarov[5]

[1]dzdimitrov@issp.bas.bg, [2]vmehandzhiev@issp.bas.bg, [3]blago@issp.bas.bg, [4]jerome@issp.bas.bg, [5]peter.sveshtarov@issp.bas.bg

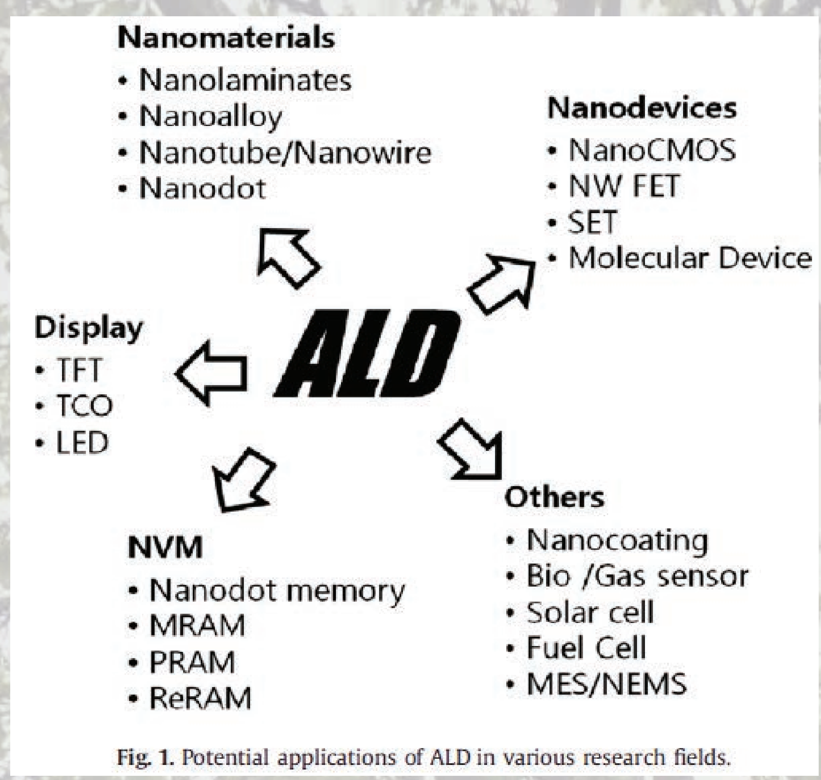
Clean Room



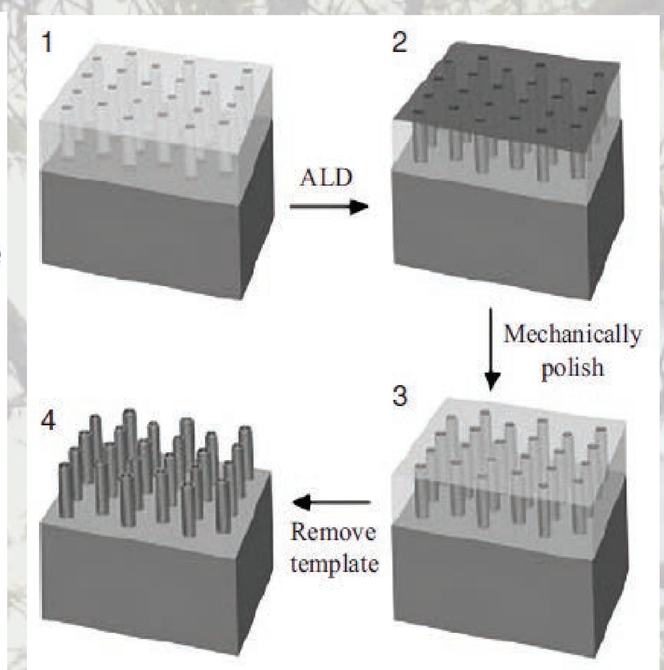
ALD is a thin film deposition technique that is based on the sequential use of a gas phase chemical process. In contrast to CVD, ALD is a 2 step process where in the 1st step one reactant has to form a self limiting monolayer on the surface. Once a monolayer of the 1st reactant is formed then the introduction of a 2nd reactant simply converts the 1st reactant to a layer of some desired solid material.



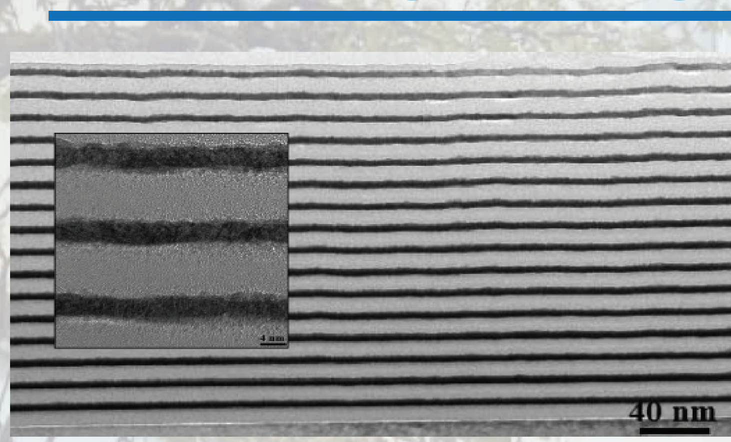
APPLICATIONS:



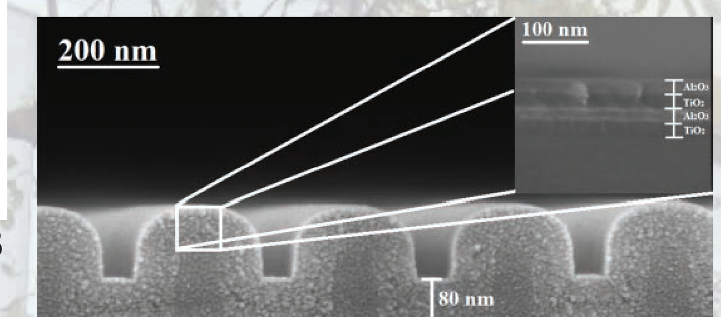
H. Kim et al. / Thin Solid Films 517 (2009) 2563–2580



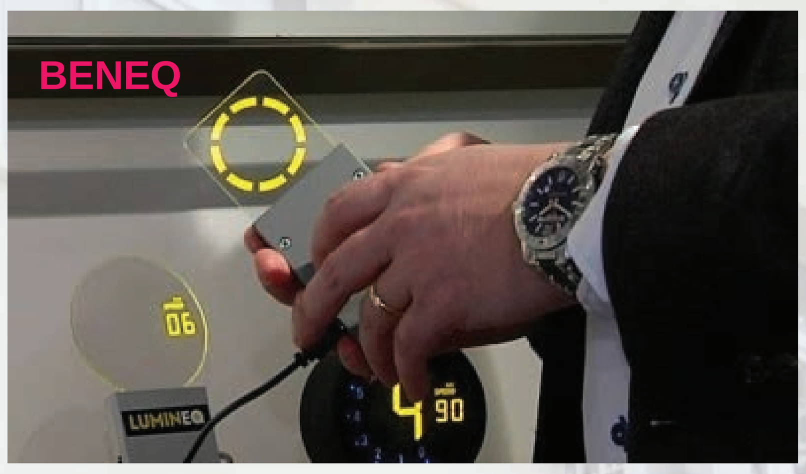
Adv. Mater. 2007, 19, 3425–3438

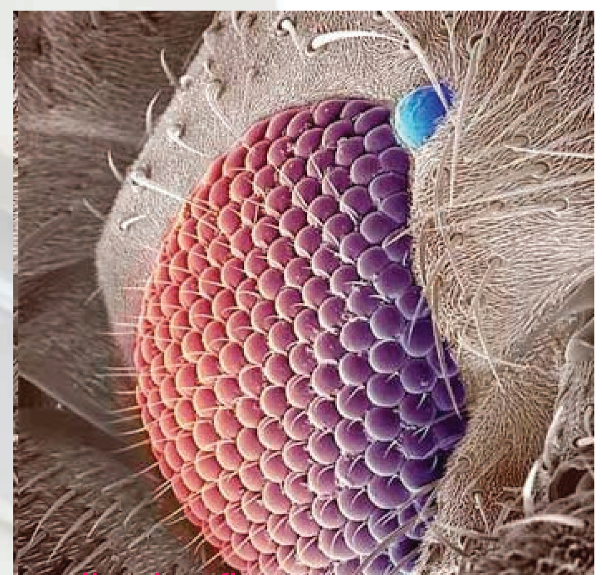


Appl. Phys. Lett. 2006, 88, 013116



TiO_2–Al_2O_3 waveguide bilayer
Nanomaterials 2015, 5, 792-803



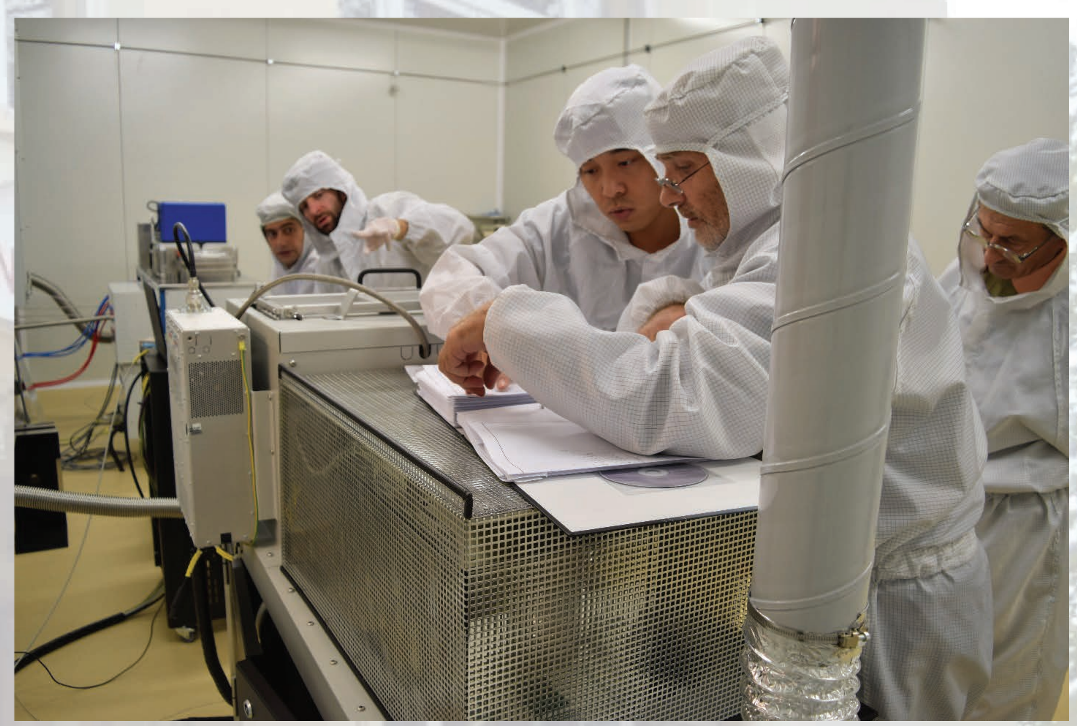


replicating fly eyes
Nanotechnology, Vol. 15, No 7

SPECIFICATIONS:

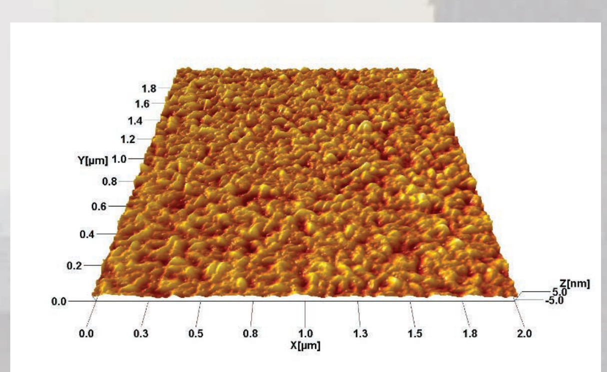
- Thermal and Plasma-enhanced modes, temperature rating up to 350 °C
- 4 liquid precursors: H_2O; DEZ; TMA; BTBAS and 3 solid precursors: NiCp2; CoCp2; FeCp2
- 6 gas lines (including ozone)
- sample chamber: Ø200 × 5 mm
- films: Al_2O_3; ZnO; ZnO:Al_2O_3; SiO_2; NiO; Ni; CoO; Co; FeO; Fe; and superlattices from the upper films.

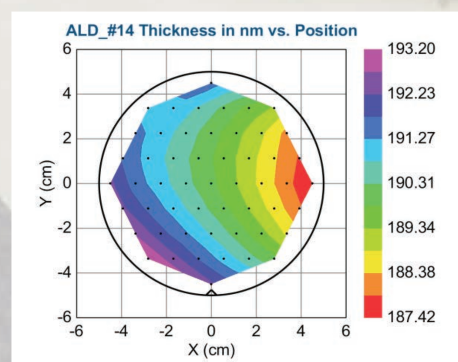
TRAINING:

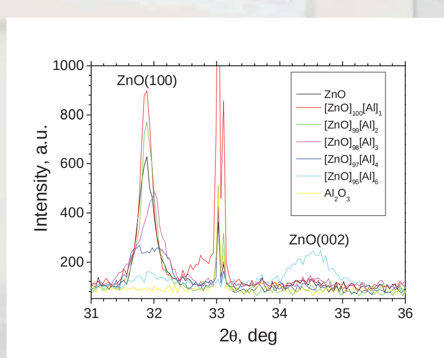


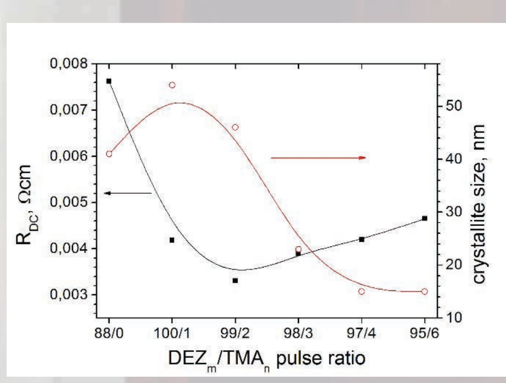
RESULTS:

Deposition of ZnO:Al_2O_3 thin films by ALD

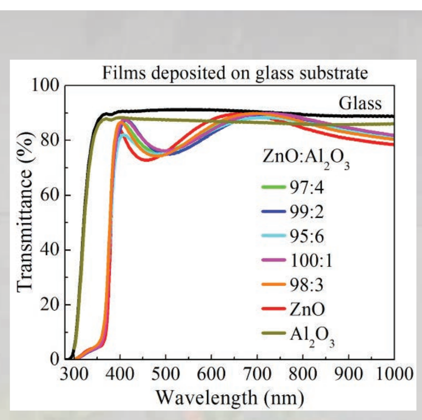


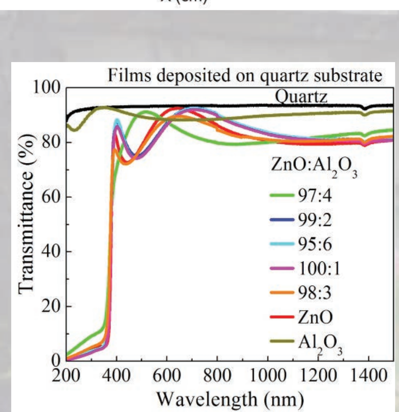


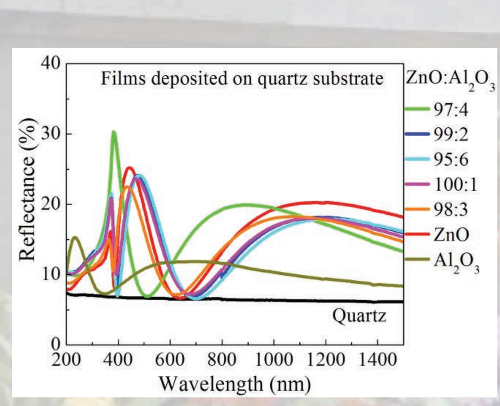


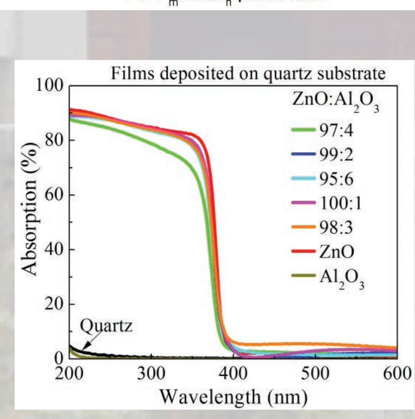


Composition	a [Å]	c [Å]	Crystallite Size [nm]
ZnO	3.259(3)	5.192(7)	41±3
$[ZnO]_{100}[Al_2O_3]_1$	3.249(2)	5.181(8)	54±6
$[ZnO]_{99}[Al_2O_3]_2$	3.246(1)	5.184(6)	46±3
$[ZnO]_{98}[Al_2O_3]_3$	3.255(3)	5.21(1)	23±2
$[ZnO]_{97}[Al_2O_3]_4$	3.269(5)	5.24(1)	15±1
$[ZnO]_{96}[Al_2O_3]_6$	3.289(7)	5.28(1)	15±1







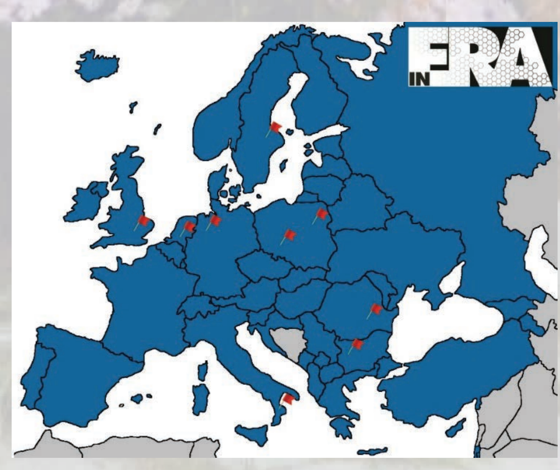


ZnO: Al_2O_3	d (nm)	f_{AlO} (%)	E_g (eV)
100:0	169	0	3.28
99:2	190	8	3.30
97:4	128	20	3.31
95:6	190	25	3.31
0:100	101	100	-
accuracy	±1	±2	±0.03

Joint studies with INERA partner

Partner Institutions: Institute of Physics at Polish Academy of Sciences (IP PAS); International Laboratory for High Magnetic Fields and Low Temperature Physics, Poland (ILHMFLT); Department of Engineering Sciences, Uppsala University, Sweden (DES UU); Fachbereich Technik, Bielefeld University of Applied Sciences, Germany (FT BUAS); The Liquid Crystal Laboratory at National Research Council (CNR) and the University of Calabria, Italy (UNICAL)

http://www.issp.bas.bg



http://www. bas.bg

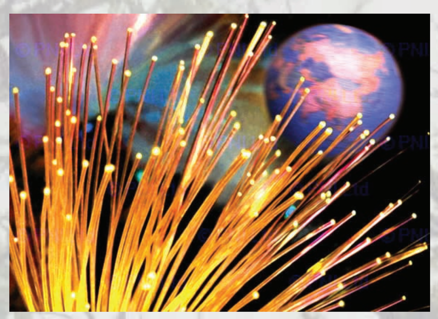
1869

Georgi Nadjakov Institute of Solid State Physics (ISSP)
Bulgarian Academy of Sciences

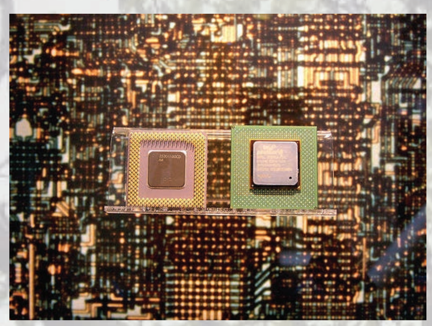
REGPOT-2012-2013-1 NMP
htpp://www.inera.org/

energy

communication



information



Femtosecond Laser System

Dr. Ekaterina Iordanova, Dr. Georgi Yankov

Department "LASER, ATOMIC, MOLECULAR AND PLASMA PHYSICS"

The femtosecond laser system consists of several units- amplifier, oscillator, pumping laser and optical parametric amplifier. The Ti:Sapphire regenerative amplifier is Spitfire Ace model with pulse width ~35 fs and pulse energy ~6 mJ. The Spitfire Ace performs optimally when seeded with Mai Tai® SP oscillator. The Spitfire Ace is pumped with Empower® 45 laser, which delivers over 45 W of average power in a compact package. The enhanced stability makes the Spitfire Ace ideal for pumping multiple optical parametric amplifier (OPA) systems.

The TOPAS Prime automated OPA is an instrument for wavelength extension of the Spitfire® Ace™ Ti:Sapphire amplifier system. Wavelengths can be generated from the deep UV range through the infrared (240–2600 nm).

MODULES AND SPECIFICATIONS:

Ultrafast Amplifier - Spitfire Ace

Pulse width	<35 fs
Pulse energy	>6 mJ
Repetition Rate	1 kHz
Beam diameter	10 mm
Polarization	Linear, Horizontal

Ultrafast oscillator - Mai Tai

Average power	>400 mW
Tuning range	780–820 nm
Peak power	> 95 kW
Beam diameter	1.5 mm
Polarization	Horizontal

Pump Laser – Empower

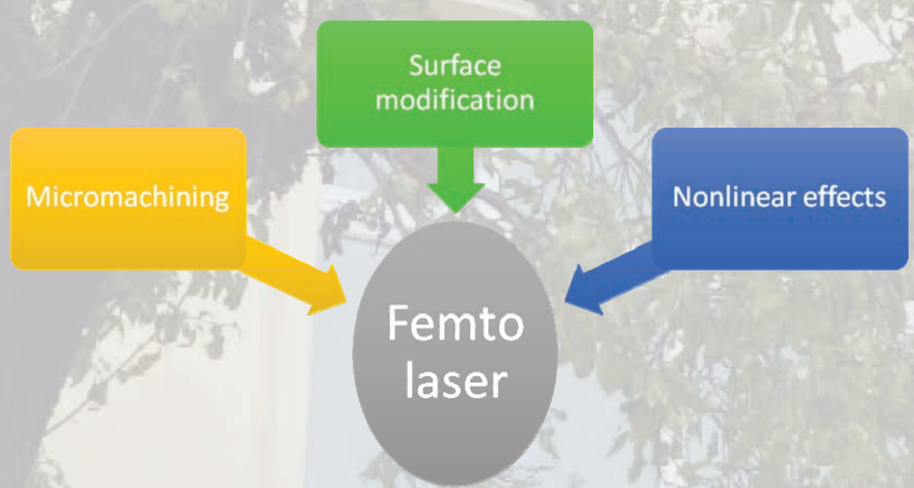
Energy per pulse	28 mJ
Wavelength	527 nm
Beam diameter	3 mm

Wavelength Converter - TOPAS P

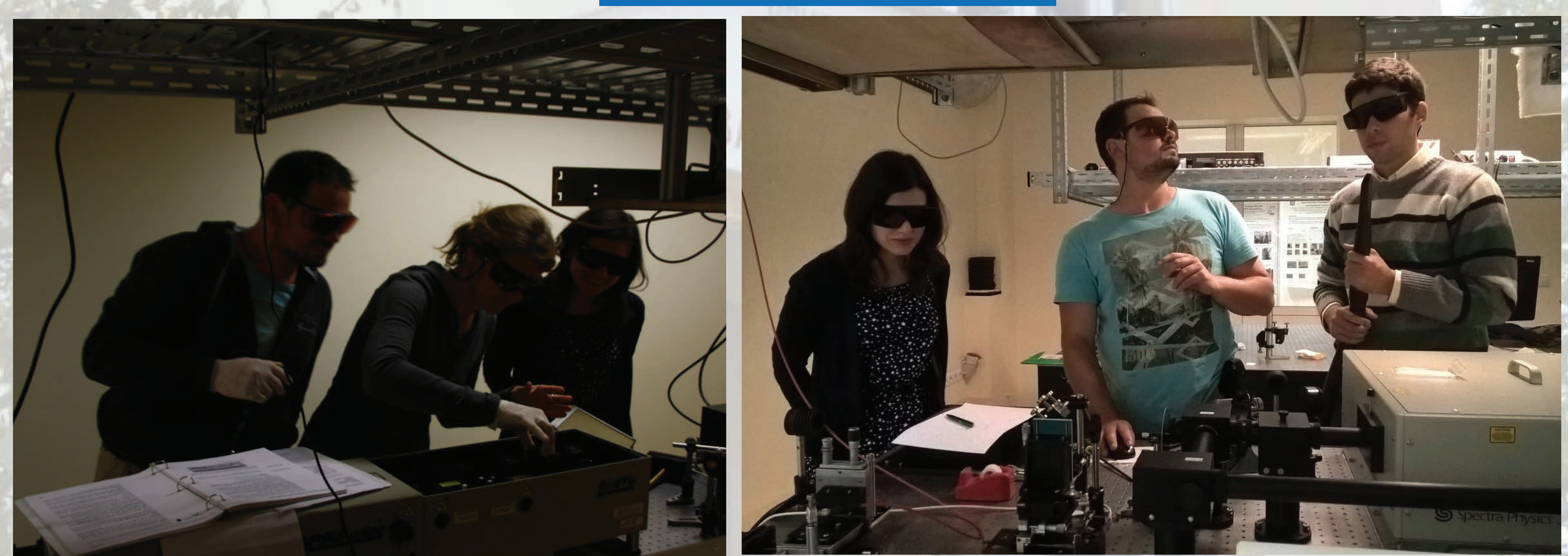
Output wavelength	240 – 2600 nm
Beam diameter	11 mm
Polarization	Linear, Horizontal

APPLICATIONS:

- Scientific Research
- Micromachining
- Medical
- Surface modification
- Bio-imaging
- Non linear effects
- Biomedical devices
- Thin film ablation



TRAINING:

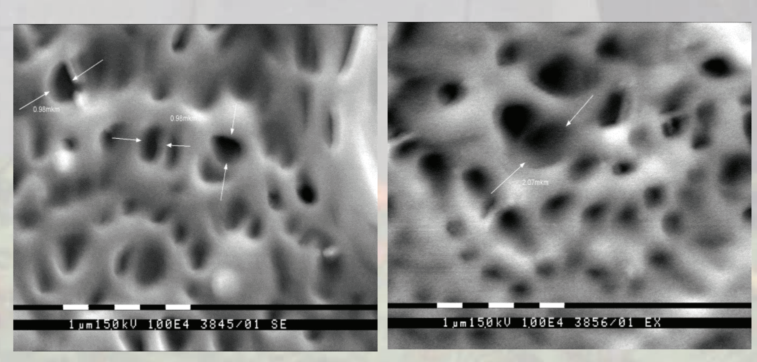


RESULTS:

The femtosecond laser treatment of materials offers advantages over chemical and other physical methods. Precise **modification** of certain **surfaces** , that are difficult to be treated with conventional methods, is enable. In tissue engineering, the three – dimensional (3D) scaffolds fabricated from polymers are used to provide structural support and guidance of cells for creation of new tissue generation. The consecution of experiments demonstrated the possibility on creation of surface micro formations, applying different laser fluences, at 1 kHz repetition rate for fixed time of exposure 1 sec at 800 nm central wavelength.

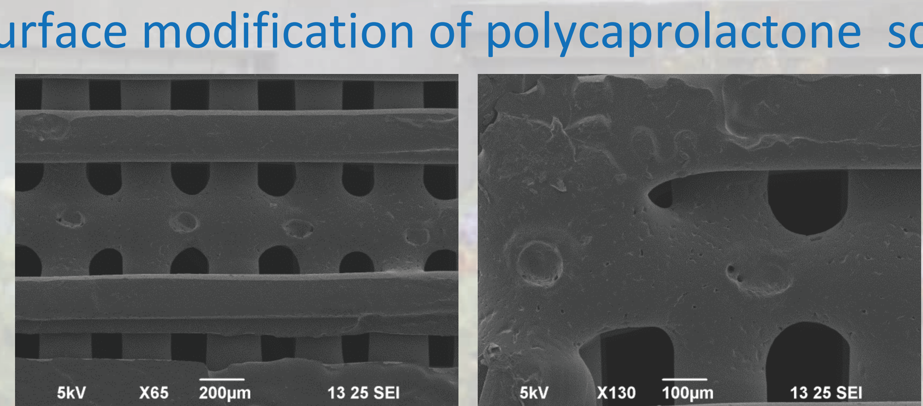
The main advantages of femtosecond laser **micromachining** are the microsized structure creation, no material property change, significant reduction or complete removal of heat-affected zone, clean process look. Some of the main applications can be seen in surface structuring, photonic devices, biomedical devices, thin film ablation, material milling, grid cutting, hole drilling.

Surface modification of gelatin thin film



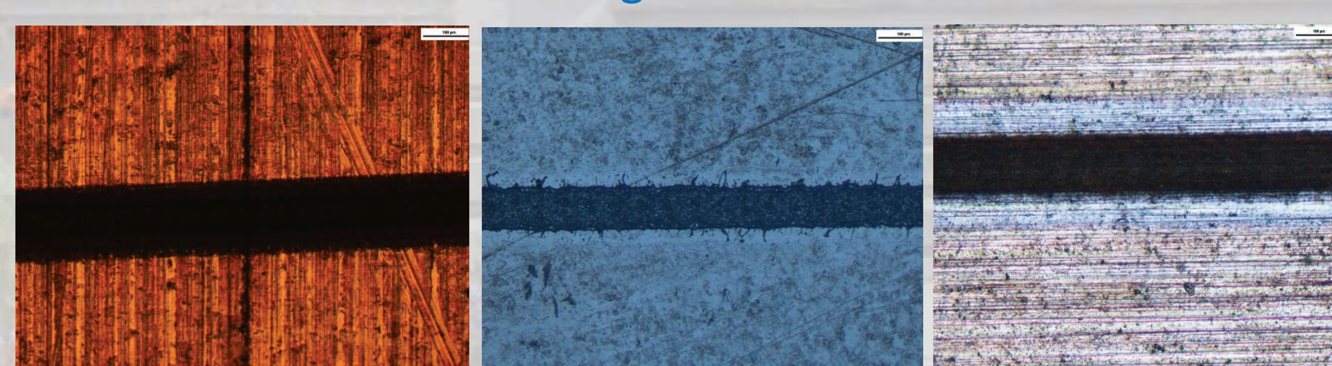
SEM image of the surface topography of thin gelatin film, laser irradiation = 35 fs, λ= 800 nm Energy – 630 – 230 μJ

Surface modification of polycaprolactone scaffolds



pulse -35 fs , λ = 800 nm, energy = 100 μJ
Line distance ~ 150 μ

Micromachining of different materials



pulse -35 fs , λ = 800 nm, cutting speed 10 mm/s

Joint studies with INERA partners:

Laser-plasma matter interaction:

National Institute for Lasers, Plasma and Radiations Physics, Romania; Eindhoven University of Technology, The Netherlands.

http://www.issp.bas.bg

Georgi Nadjakov Institute of Solid State Physics (ISSP)
Bulgarian Academy of Sciences

1869

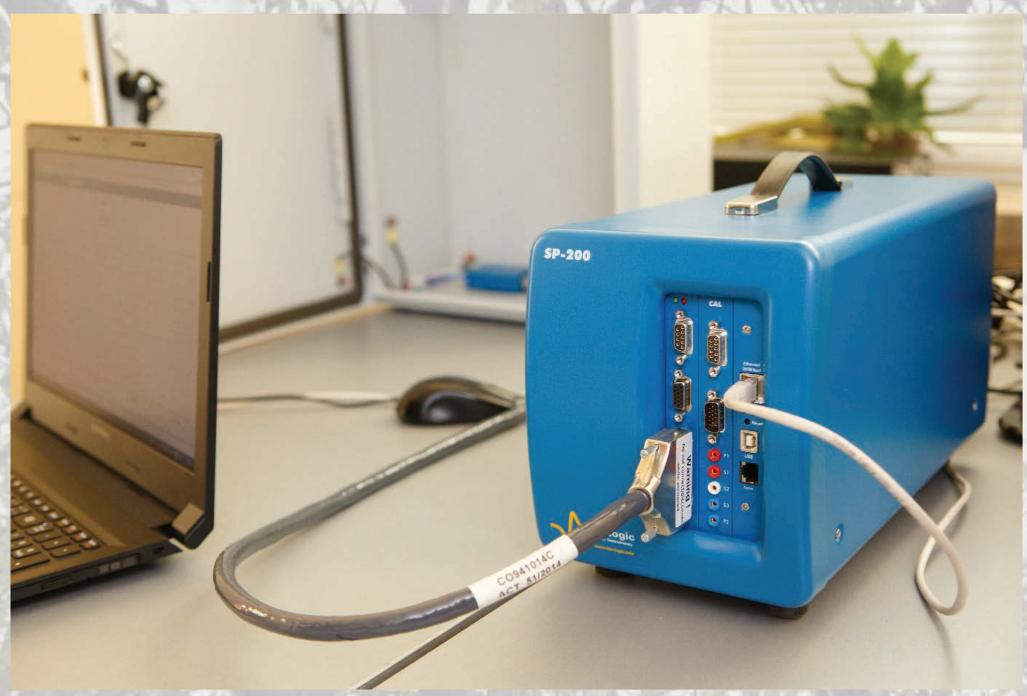
http://www. bas.bg

REGPOT-2012-2013-1 NMP
shttp://www.inera.org

Portable Potentiostat and Galvanostat SP-200

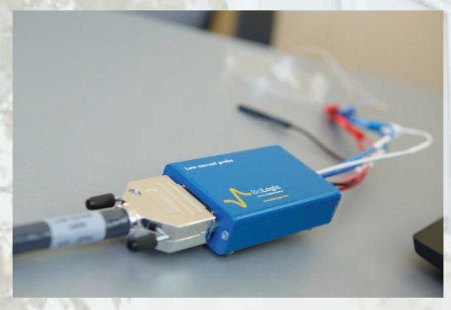
Dr. M. Iliev, Dr. Y. Marinov
DIVISION SOFT MATTER PHYSICS

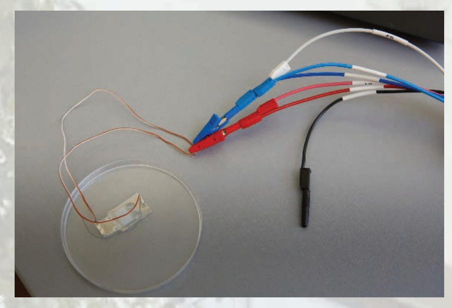
The modular potentiostat/ galvanostat SP-200 incorporating the latest technology has excellent specifications and can be applied as universal measurement device with main field of application in electrochemistry research. SP-200 offers floating mode, analog filtering, built-in calibration board and excellent electronic stability for better cell control. The electrochemical workstation has been equipped with an ultralow current probe, which extends the current range down to 1 pA; the upper current range is 500 mA. Electrochemical impedance spectroscopy measurements in the frequency range from 10 μHz to 3 MHz are an additional option of the purchased instrument. The device is suitable for studying electrical and dielectrical properties of multifunctional nanostructures. As well as by dielectric permittivity and dielectric loss measurements performance of electric devices can be evaluated.



MODULES:

- Work station
- Ultralow current probe
- Portable computer
- Faradey cage





APPLICATIONS:

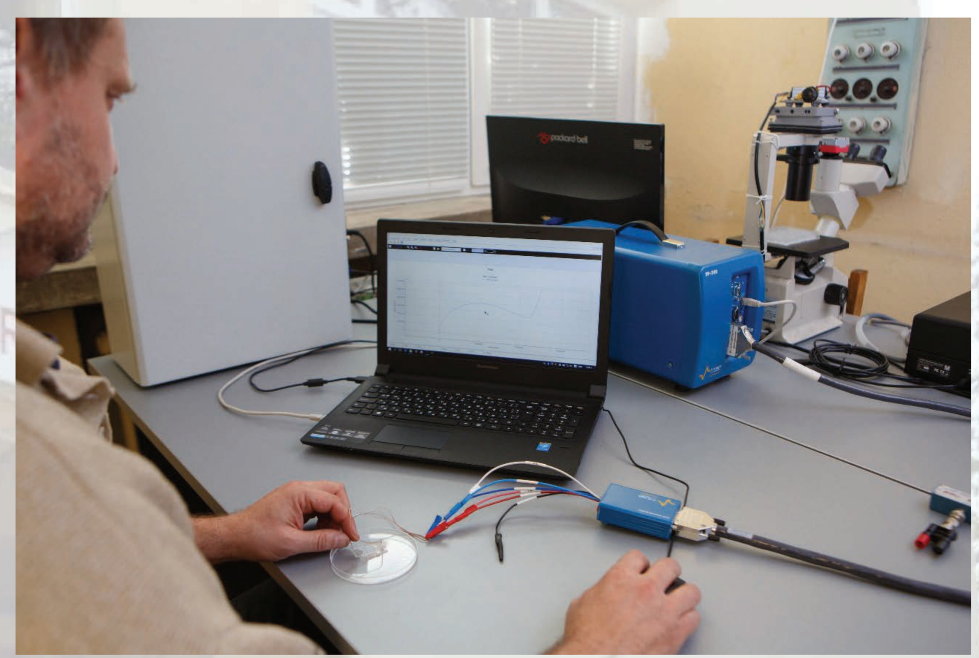
Compact and powerful electrochemical workstation SP-200, Bio-Logic instruments is designed for a variety of domains and applications:

- **Materials testing**
- **Electrophysiology**
- **photovoltaics**
- **fuel cells**

SPECIFICATIONS:

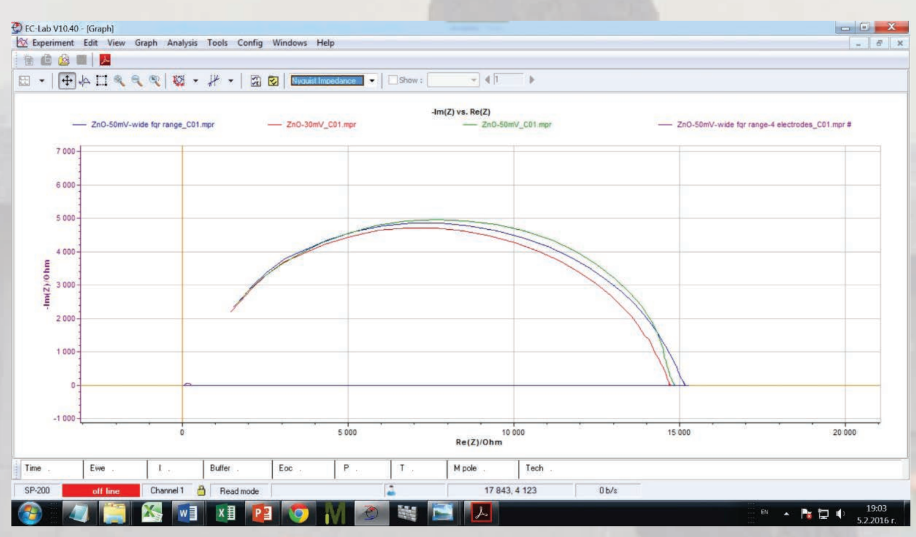
- **Compliance voltage ±10 V**
- **EIS capability 10 μHz to 3 MHz**
- **Current ranges with low current option 1 pA to 500 mA (with gain)**
- **Current resolution 76 aA**
- **Input impedance 100 TΩ (//6 pF)**

TRAINING:

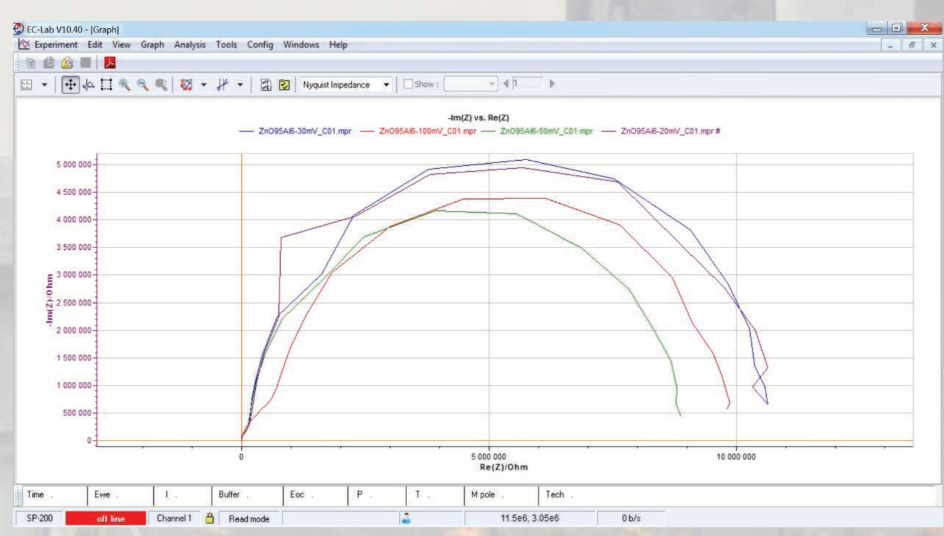


RESULTS:

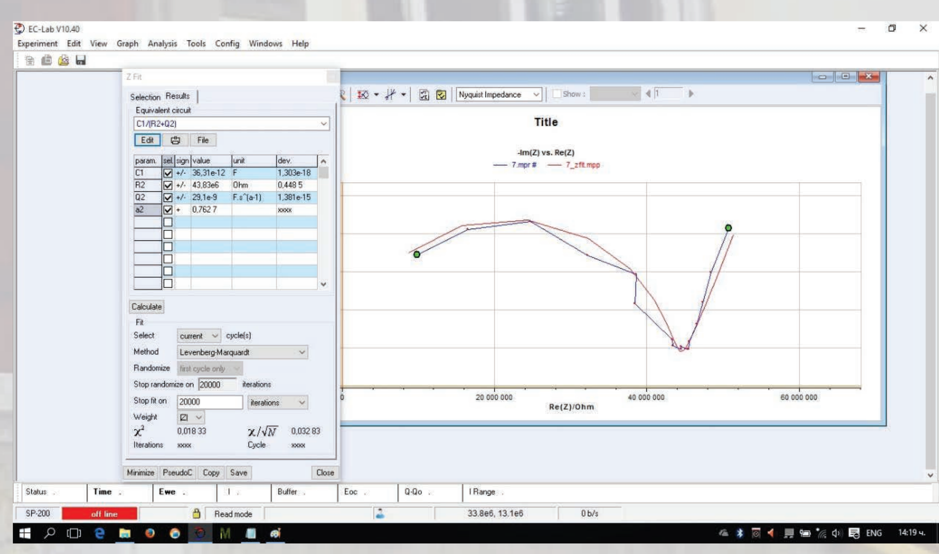
Results on impedance spectroscopy study of ZnO-Al_2O_3 thin films deposited on silicon substrates by Atomic Layer Deposition (ALD) system, purchased in the frame of the Project INERA, are presented.



Impedance spectra of ALD Al_2O_3 layer.



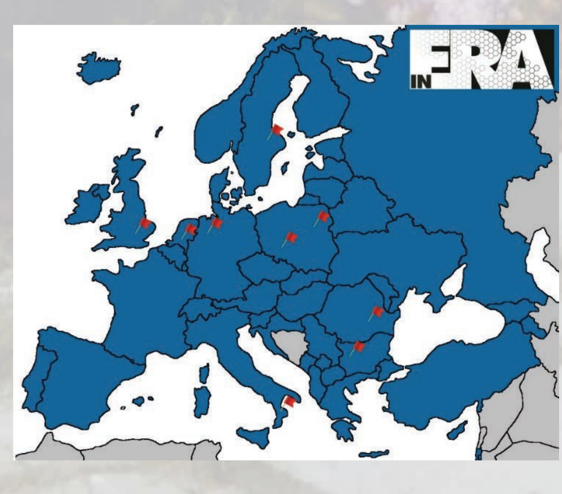
Impedance spectra of ALD ZnO:Al layer.



Impedance spectra of nanostructured liquid crystal gel

Joint studies with INERA partner:

Materials studied: Metal oxides (Al_2O_3, ZnO) and nanostructured liquid crystals films.
Partner Institutions: Dipartimento di Fisica, Università della Calabria, Via Pietro Bucci, Cubo 31C, 87036 Rende (CS), Italy



http://www.issp.bas.bg

Georgi Nadjakov Institute of Solid State Physics (ISSP)
Bulgarian Academy of Sciences

http://www. bas.bg

REGPOT-2012-2013-1 NMP
shttp://www.inera.org

MAXIMEM Membrane Filtration Unit

Dr. D.Mitev, Dr. D.Peshev

WG4 – Nanomembrane and liquid crystal nanostructures: research and applications

MAXIMEM laboratory membrane filtration system (Prozesstechnik GmbH) with its compact and flexible construction gives possibilities for performing all pressure driven membrane processes. The system is made of stainless steel frame, frequency controlled pump, temperature controller for the jacketed feed vessel, flexible membrane modules and electronic display. The experimental conditions for operating pressure, pump throughput, temperature, permeate flux, etc. are precisely controlled and recorded for further analysis. The modern filtration set-up delivers a variety of possible application as extraction and concentration of herbal substances for pharmaceutical usage, purification and desalting of valuable products, bigger scale membrane filtration, etc. The capabilities for separation of thermally and chemically unstable substances make the equipment unique for the purpose.

MODULES:

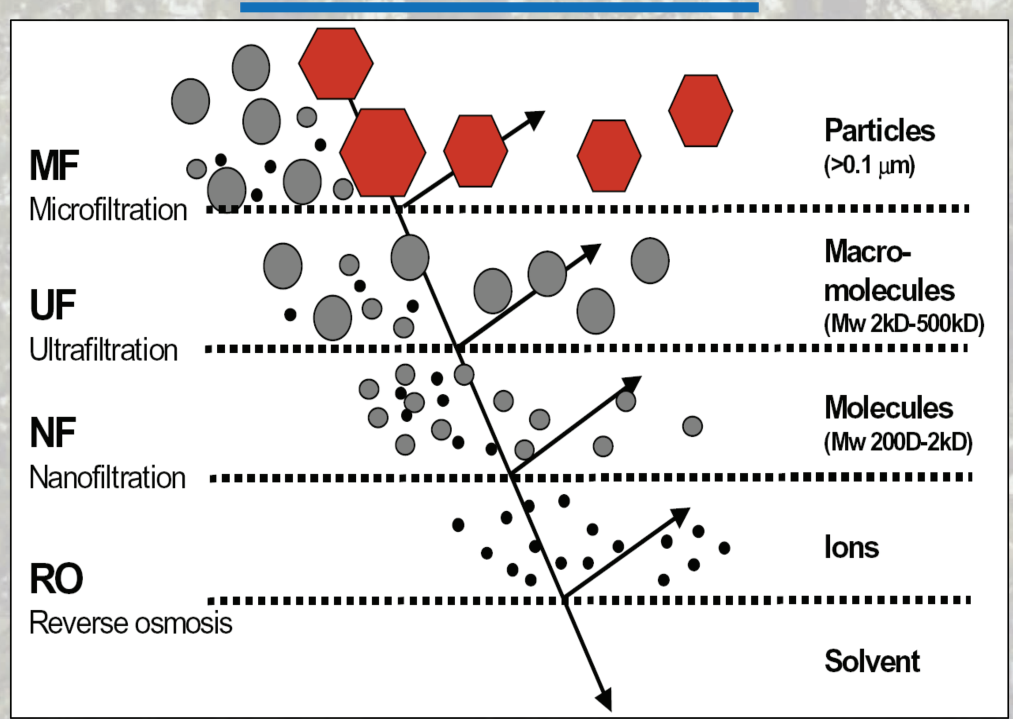
• Control Unit for automatic diafiltration and continuous operation. Main functions:
· *Automatic diafiltration at constant level*
· *Convert the basic membrane unit from batch unit into a continuously operating*

Other purposes:
· *Simple metering pump unit to pump liquids at well defined flow rates*
· *Approximate permeate flow meter (accuracy within +/-5% of the measured value)*

APPLICATIONS:

▶ High reverse osmosis, nanofiltration, ultrafiltration, microfiltration
▶ Concentration, diafiltration, loop operation, batch and continuous
▶ Membrane filtration with larger amounts of product
▶ Concentration, purification and desalting of valuable products, waste stream treatment and recycling

OPTIONS:



TRAINING:

SPECIFICATIONS:

- Operating pressure: up to 60 bar
- Temperatures: within 0°- 60°C

RESULTS:

Spent coffee extracts recovery: using dead-end nanofiltration, with a feed of 600 mg L^{-1} GAE*, we managed to concentrate to 2075 L^{-1} GAE with a single process (fresh short espresso 4400 mg L^{-1}). Recovery 0.88 according to Folin-Ciocalteu analytic method for antioxidants / reducers.

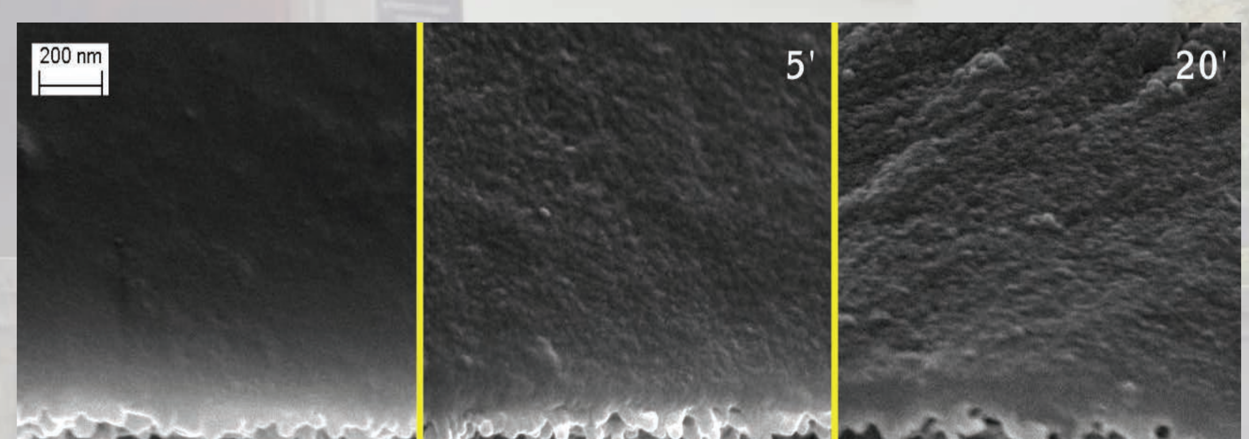
PECVD-assisted membrane modification: Low-temperature plasma processes rendered possible an application of several type of coatings: siloxane (dense and well differentiable; they exhibit dual-mode mechanism of the deposition combined with hetero-inclusions within the layers). On the contrary, films derived by aliphatic hydrocarbons are rather loose, but uniform polymer deposits. Although having some specifics, toluene-based films show close proximity with the pentane-derived ones.

**GAE: Gallic acid equivalents*

(from left) Spent coffee feed extract, permeate and concentrate

membrane modification PECVD setup

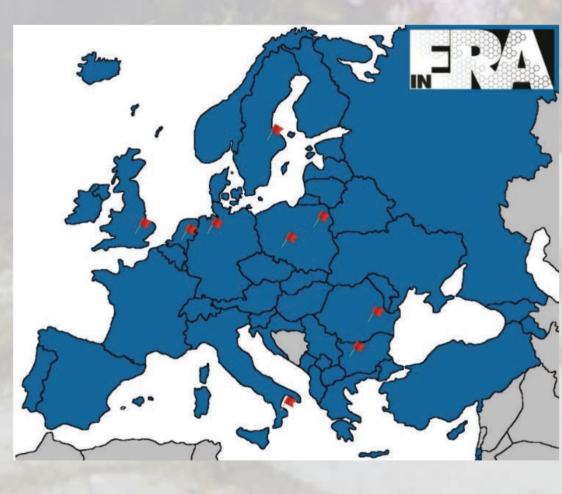
Contact angles for plain substrate and the plasma-deposited films type H (20 min), P (5 min) and T (20 min deposition)



Plain polymer substrate (left), and plasma coated (Pentane 5 and 20 min; right). The thicknesses of the coatings are 12 and 85 nm (quartz resonator). Magnification 100.00k

Joint studies with INERA partner:

Materials studied: Membrane processes for spent coffee treatment. Membranes modification through PECVD approaches.
Partner Institutions: Department of Chemical Engineering and Chemical Technology, Imperial College, UK (Prof Andrew Livingston & Dr Ludmila Peeva)



REGPOT-2012-2013-1 NMP
shttp://www.inera.org/

Automated Microfluidic Platform CellASIC® ONIX, Millipore Merck

Dr. Yordan Marinov;
e-mail: ymarinov@issp.bas.bg

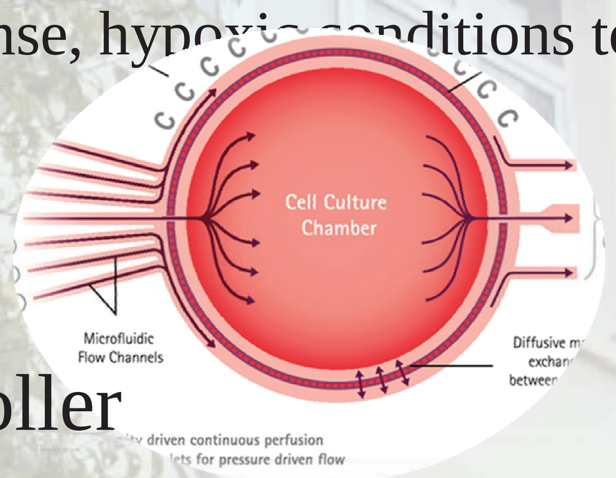
Dr. Julia Genova;
e-mail: julia.genova@issp.bas.bg

LABORATORY BIOMOLECULAR LAYERS

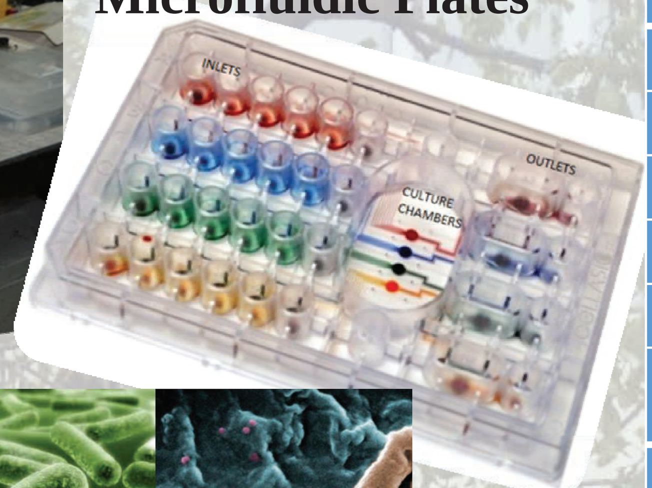
An automated microfluidic platform CellASIC® ONIX, Millipore Merck for dynamic cell culture analysis and environmental has been delivered and installed. The CellASIC™ ONIX Microfluidic Platform with its novel beneficial features gives multiple opportunities for long-term live cell analysis experiments by combining the highest precision controls, maximum functionality, and simplified user operation. Cutting edge microfluidics technology provides an improved cell culture microenvironment control, exceptional quality for high magnification microscopy, and superior media switching capabilities. The newly delivered system allows a variety of possible applications as 3D cell culture, migration in reponse to chemogradient, cell response to changing media conditions, neural stem cell analysis, host-pathogen interactions, bacteria and yeast single cell response, hypoxic conditions to mimic tumor environments.

MODULES:

- Microfluidic platform
- Microincubator controller
- Tri-gas mixer



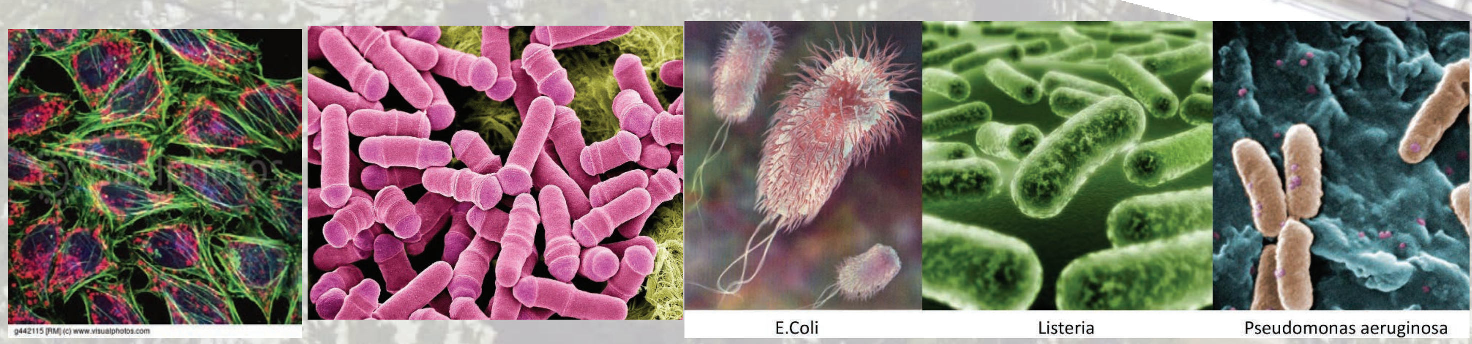
Microfluidic Plates



	Function	Minimum Volume (µL)	Maximum Volume (µL)
Inlet 1	Inlet for gravity-driven perfusion	10	350
Inlet 2	Inlet for gradient establishment	50	350
Inlet 3	Inlet for gradient establishment	50	350
Inlet 4	Inlet for gradient establishment	50	350
Inlet 5	Inlet for gradient establishment	50	350
Inlet 6	Cell inlet for loading cells into culture chamber	10	350
Outlets 7 and 8	Accept flow-through from culture chamber	50	900*

APPLICATIONS:

- Cell response over time
- Interrogating 3D cell culture
- Chemotaxis/migration
- Drug dose/response
- Neural stem cell analysis
- Host-Pathogen interactions
- Hypoxic conditions to mimic tumor environments
- Bacteria single cell analysis
- Yeast single cell analysis



Mammalian M04 Yeast Y04 Bacteria B04

SPECIFICATIONS:

Microfluidic System

Outputs	
Number of outputs	8
Pressure range	0–0.7 bar (0–10 psi)
Pressure accuracy	10.3 mbar (± 0.25 psi)
Pressure stabilization time	< 5 seconds
Optional inputs	
Pressure supply	Clean, dry air, nitrogen (N_2), or argon regulated between 2.1 and 6.9 bar (30 and 100 psi).
Vacuum	Steady vacuum regulated between 711 millibar (21 in. Hg) and perfect vacuum
Gas mixture	Flow rate of 3–100 mL/min
Cell Culture Region Gas Environment Accuracy	
For gas flow at 3 mL/min For gas flow at 20 mL/min	< 10% deviation from delivered gas < 2% deviation from delivered gas

Microincubator controller

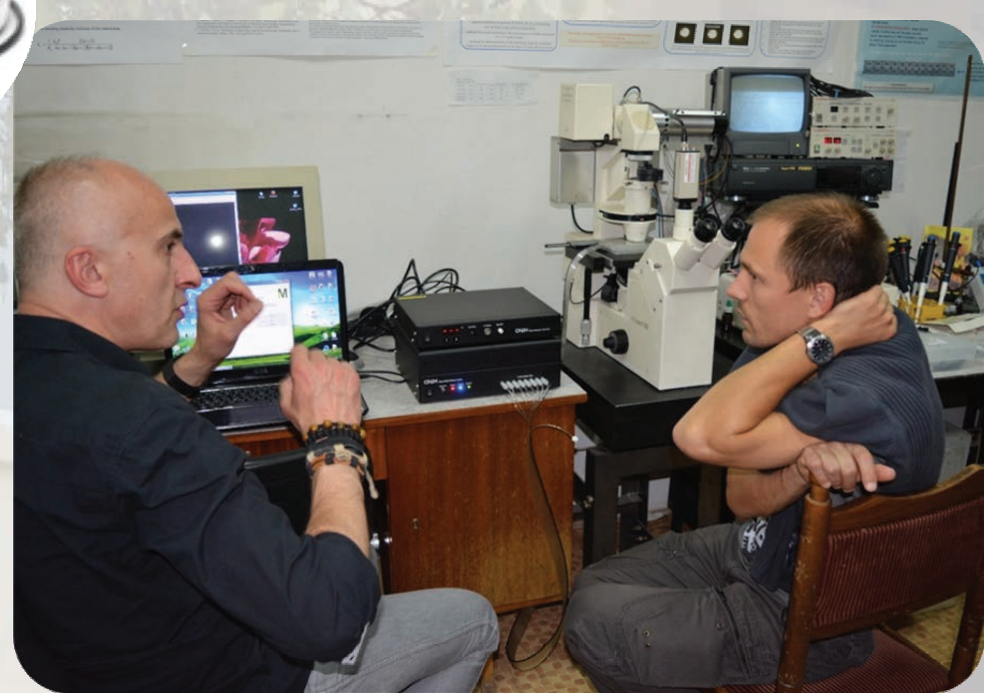
Temperature Control	
Temperature control range	Room temperature to 40 °C
Control method	Bi-directional PID
Set method	Up and down keys, increment 0.1 °C
Achievable stability	± 0.2 °C
Rise time (25 °C to 37 °C)	< 10 minutes
Cooling time (37 °C to 25 °C)	< 15 minutes
Calibration plate accuracy	± 0.1 °C
Optional gas flow	
Flow rate	3.0 mL/min typical, ± 0.5 mL/min
Premixed gas input	Clean, dry, premixed gas containing air, CO_2, N_2, and oxygen (O_2) up to 25%, regulated to 3.1–3.8 bar (45–55 psi)
Cell Culture Region Gas Environment Accuracy	
For gas flow at 3 mL/min For gas flow at 20 mL/min	< 10% deviation from delivered gas < 2% deviation from delivered gas

Tri-gas mixer

General	
Gas supply requirements	Compressed air, N_2, and CO_2 Clean and dry, > 99.5% pure Regulated to 2.1–6.9 bar (30–100 psi)
Gas supply consumption	Air, 0–100 mL/min N_2, 0–120 mL/min CO_2, 0–10 mL/min
Ouputs	
Mixed gas	0% or 1–21% 02 0% or 1–15% CO_2
Flow meter accuracy	± 2% of full scale at 21 °C
Flow meter stability	± 0.20% CO_2 per 1 °C*
Flow meter drift	± 0.1% CO_2 per day*

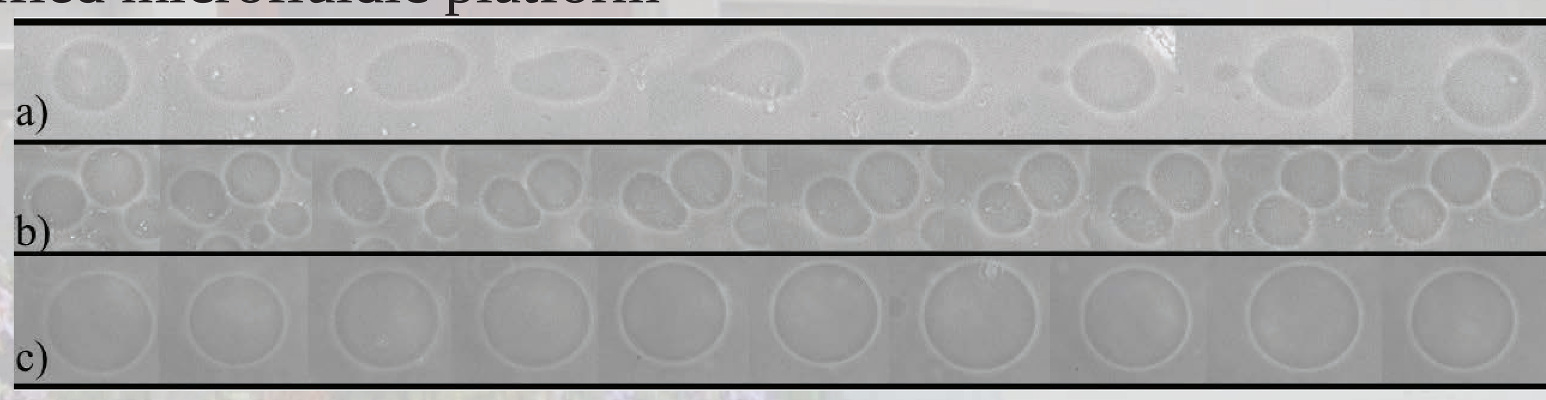
TRAINING:

Pawel Kroliczak, technical manager at Merck Millipore performed the installation of the microfluidic platform and demonstrated some of its possible applications. Four young specialists from ISSP-BAS, namely Dr. Janez Pavlic, Dr. Victoria Vitkova, Dr. Julia Genova and Denitza Mitkova have been trained to operate the system and ave received certificates.



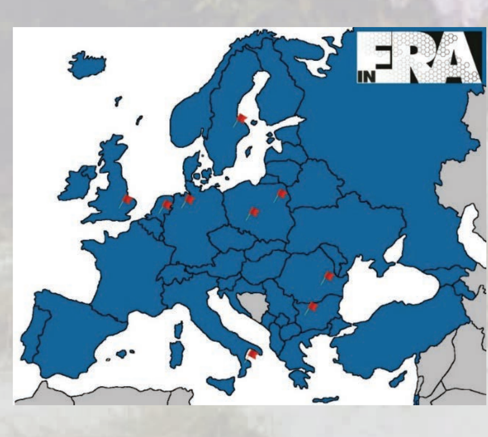
RESULTS:

Study of the morphology of lipid vesicles in presence of Amphotericin B via modified microfluidic platform



Morphology of lipid vesicles in addition of a) amphotericin B in concentration 10^{-5} g/l in the outer vesicle environment; b) amphotericin B in concentration 10^{-3} g/l in the outer vesicle environment; c) control with addition of glucose solution.

J. Genova, M. Dencheva-Zarkova, J. I. Pavlič, Morphological study of lipid vesicles in presence of amphotericin B via modification of the microfluidic CellASIC platform and LED illumination microscopy, **Journal of Physics: Conference Series 682 (2016) 012029**.



http://www.issp.bas.bg

Georgi Nadjakov Institute of Solid State Physics (ISSP)
Bulgarian Academy of Sciences

http://www. bas.bg

REGPOT-2012-2013-1 NMP
shttp://www.inera.org

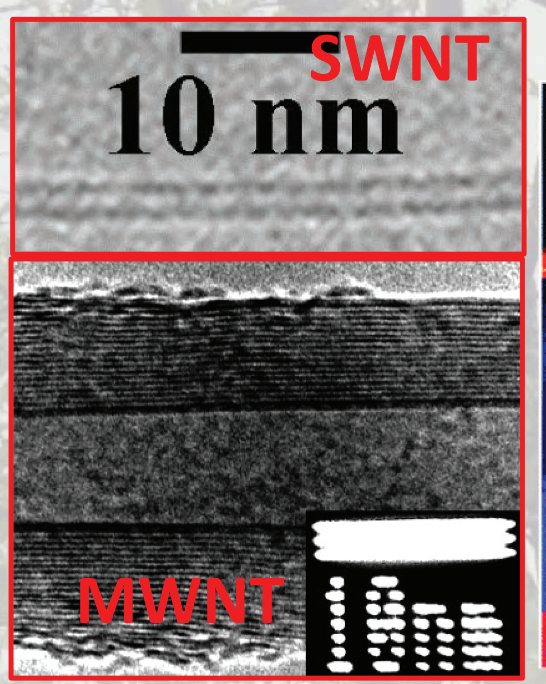
Plasma Enhanced Chemical Vapor Deposition reactor Oxford Instruments Plasmalab 100

Dr. P. Sveshtarov, Dr. J. Leclercq, Dr. V. Mehandzhiev, Dr. B. Blagoev and Dr. D. Dimitrov

CLEAN ROOM

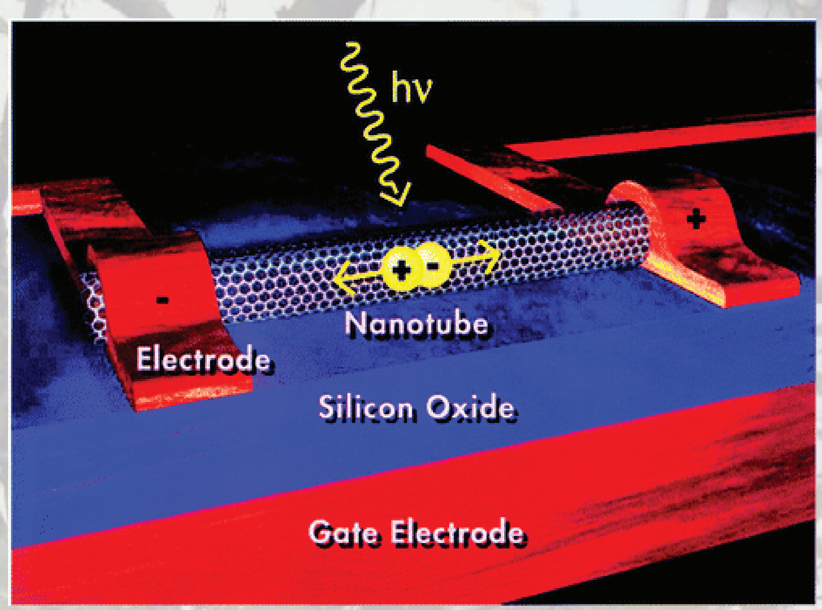
Plasma-enhanced chemical vapor deposition (PECVD) is a process used to deposit thin films from a gas state (vapor) to a solid state on a substrate. The Oxford Instruments PlasmaLab 100 PECVD reactor can work like PECVD or LPCVD (Low pressure chemical vapor deposition). It is used to grow graphene and carbon nanotubes at Nanocenter ISSP-BAS

APPLICATIONS:



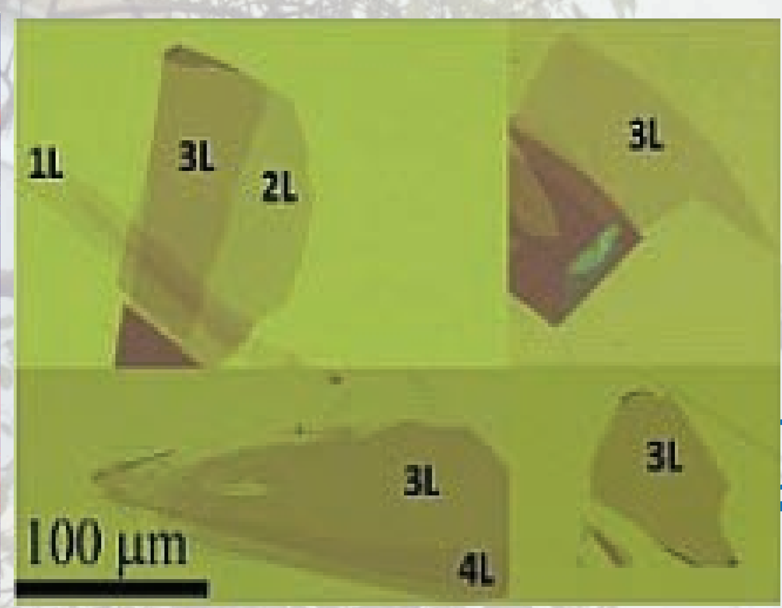
10.1088/0963-0252/12/2/312

Photodetector

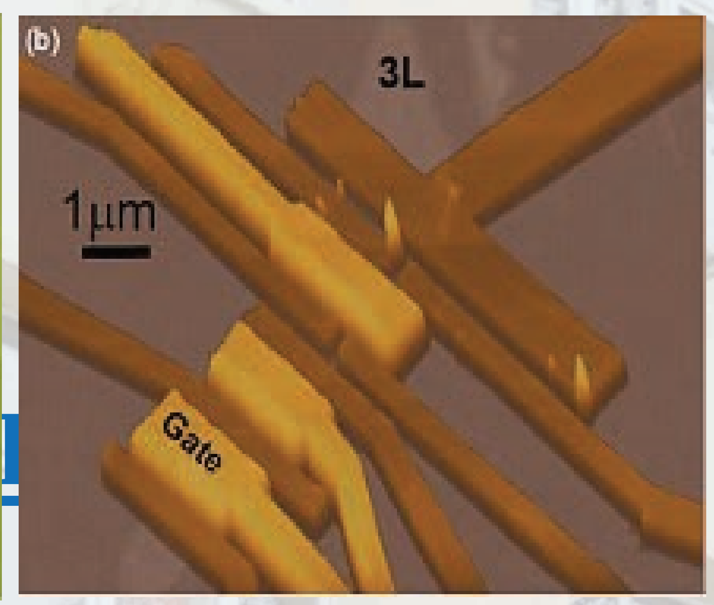


10.1021/nl034313e

Graphene layers

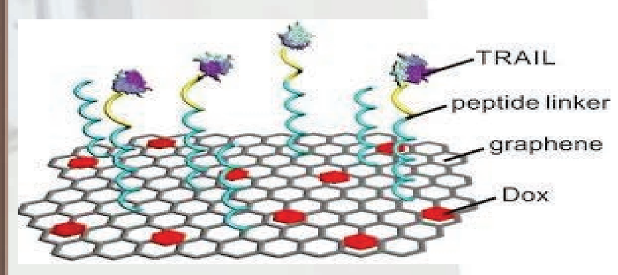


AFM of graphene transistor



10.1016/j.nantod.2010.12.001

Drug delivery



10.1002/adma.201404498

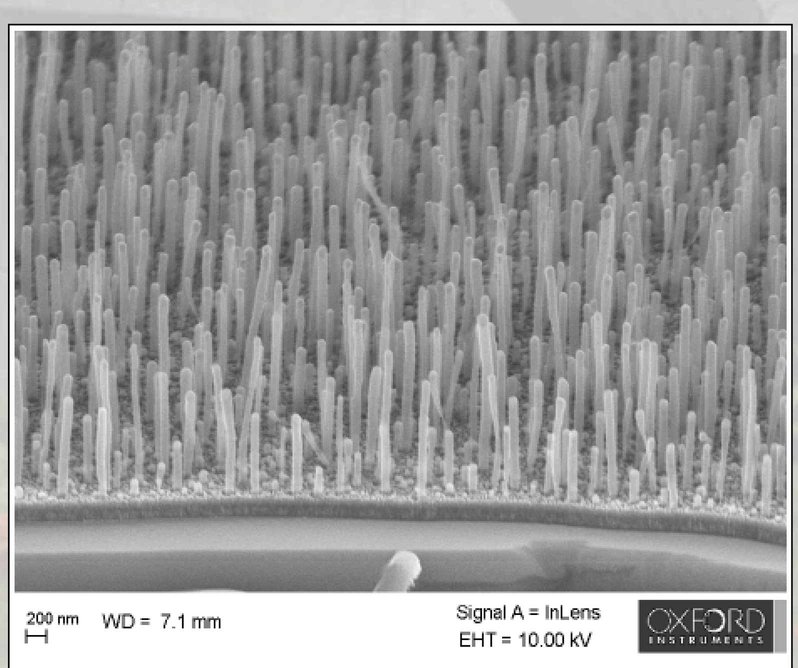
SPECIFICATIONS :

- Temperature range from room temperature up to 1200 °C
- Low (200kHz) and High (13.56MHz) frequency plasma
- Automatic load power control (0-300W)
- Continuous or pulsed plasma mode
- Vacuum loadlock with dry pump
- 7 gas lines : Ar and H_2 as carrier gas, N_2, C_2H_2, NH_3, CH_4, O_2 and H_2 as reactive gases
- Substrate size up to 200 mm

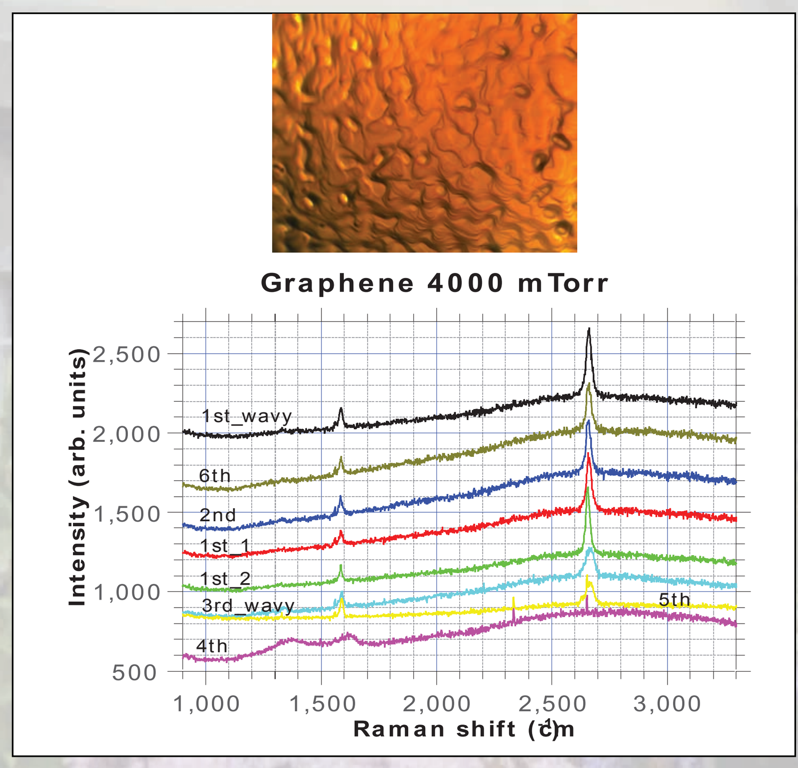
TRAINING:

RESULTS:

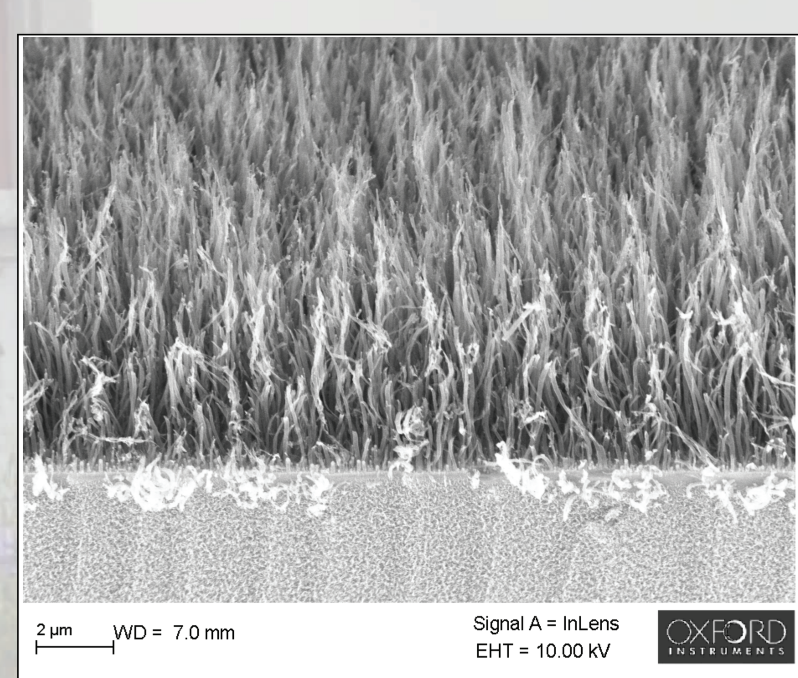
Graphene was grown on copper substrates at different low pressures by thermal CVD and characterized by Raman spectroscopy and SEM. The graphene samples show good quality and are consistently mono-layered, confirmed by the Raman spectra. Carbon nanotubes were grown by PECVD using RF plasma precursor activation and deposition steps. Curled tangled nanotubes, straight well aligned nanotubes and 3 µm long nanotubes were obtained. Both processes are being refined and optimized to ensure reproducibility and quality.



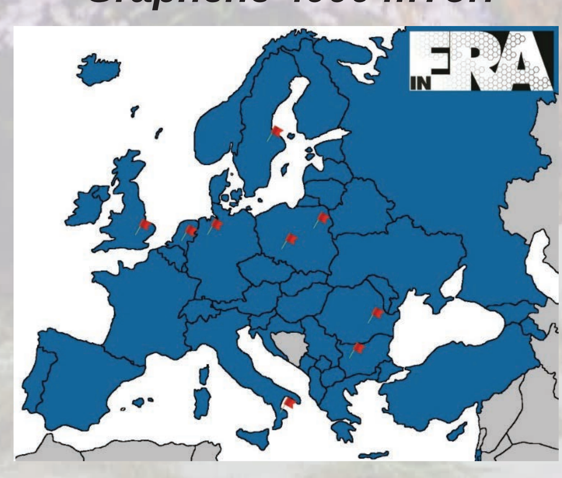
Straight well aligned Carbon Nanotubes



Graphene 4000 mTorr



Long Carbon Nanotubes



REGPOT-2012-2013-1 NMP
shttp://www.inera.org

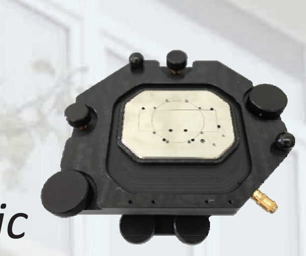
Spectroscopic Ellipsometer Woollam M2000D

Dr. A. Szekeres, Dr. P. Terziyska and Dr. T. Hristova-Vasileva

DIVISION NANOPHYSICS

M2000D ellipsometer, working with rotating compensator, is designed for optical characterization of thin dielectric, semiconductor, organic layers and multilayer structures and liquid samples. The spectral range of 195-1000 nm is especially suitable for determining the optical constants and thickness of semiconductor and oxide films. Measurement at short wavelengths increases the sensitivity of the device to ultrathin films with thicknesses less than 0.1 nm. Besides film thickness and optical constants, other properties as composition, crystallinity, anisotropy, surface and interface roughness, etc. can be determined, as well as lateral inhomogeneity can be registered by automatic sample mapping.

MODULES:



- Instex Heat Stage
(Temperature range for ellipsometric measurements: approximately - 80° to 600°C; Angle of incidence range: 45° - 90°)

- 500 µl Horizontal Liquid Cell
(Nominal angle of incidence : 70°)
- Automated 300x300 mm XY mapping

APPLICATIONS:

High accuracy and precision in a wide spectral range and fast data recording make M2000D a powerful tool for in-situ monitoring and process control, large-area uniformity mapping and thin film characterization.

SPECIFICATIONS:

- Spectral Range: 193 to 1000 nm
- Angle of Incidence Range: 45° - 90°

OPTIONS:

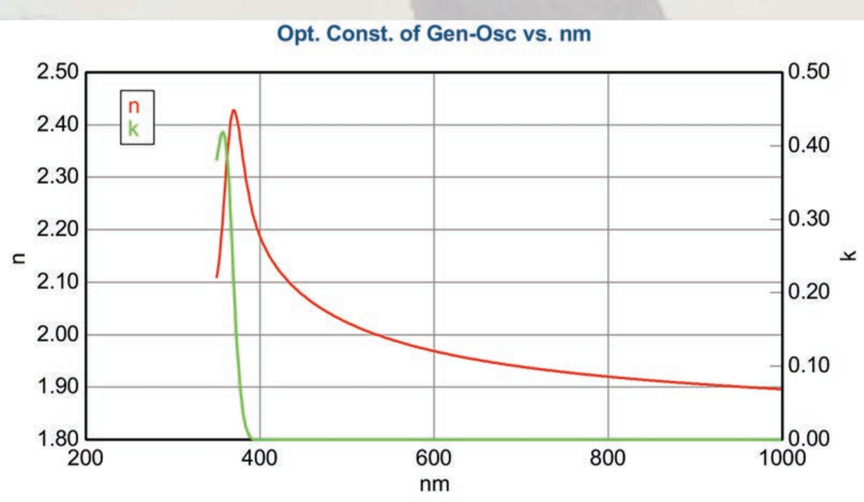
- Horizontal Auto translation stage (100 mm X-Y)
- Focusing Optics (300 µm beam size)

- Computer controlled sample positioning system and automated z-height adjustment

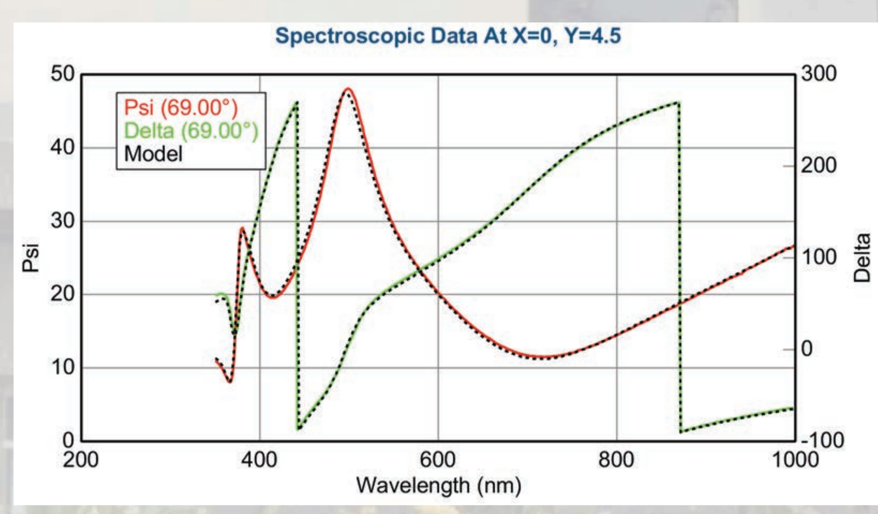
TRAINING:

RESULTS:

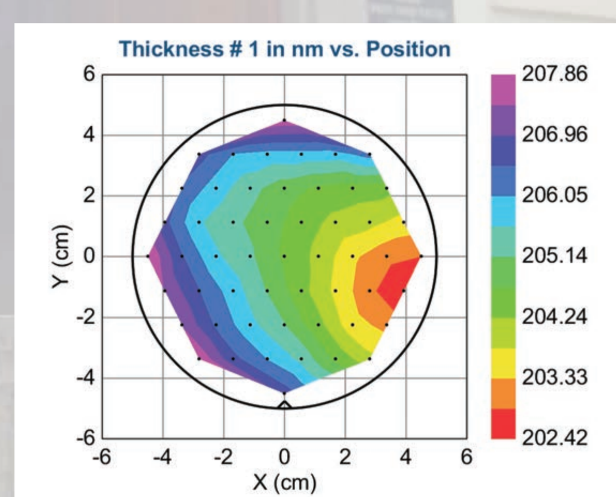
Results on spectroscopic ellipsometry study of ZnO-Al_2O_3 thin films deposited on silicon substrates by Atomic Layer Deposition (ALD) system, purchased in the frame of the Project INERA, are presented. The wavelength dispersion curves of the refractive index *n* and the extinction coefficient *k* of the ZnO layers are determined from the General Oscillator model of the experimental ψ and Δ data. The 2D maps of the ZnO films deposited on 4 inch Si wafer show good thickness homogeneity and low surface roughness.

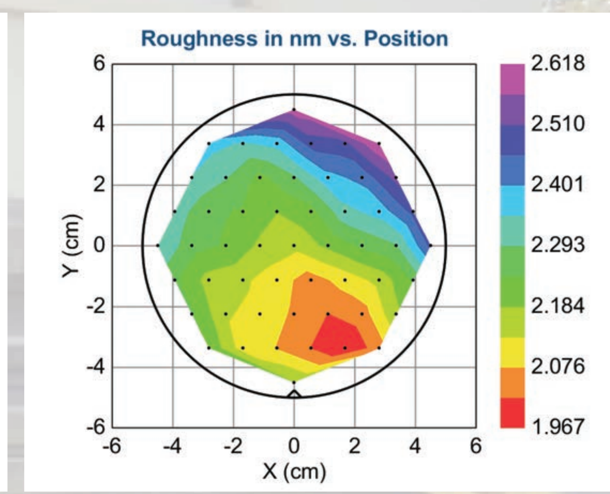


Refractive index and extinction coefficient dispersion of ALD ZnO:Al layer.



Ψ and Δ measured and fitted with the GenOsc model.

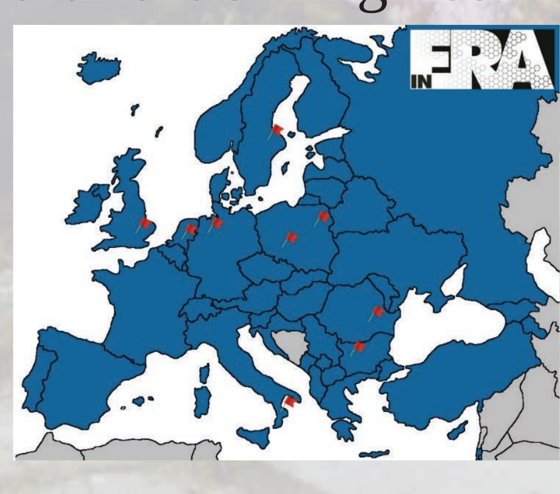




Thickness variation map and roughness variation map of the ZnO:Al layer deposited on a 4 inch Si wafer.

Joint studies with INERA partner:

Materials studied: Metal oxides (Al_2O_3, ZnO, TiO_2, CoO, FeO, NiO, ZnMgO, WO_3-MoO_3) and nitrides (AlN, GaN) and DLC films.
Partner Institutions: Institute of Physics at Polish Academy of Sciences (IP PAS); National Institute for Lasers, Plasma and Radiation Physics, Romania (NILPRP); Department of Engineering Sciences, Uppsala University, Sweden (DES UU)



INVESTING IN YOUR FUTURE

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Bulgarian Academy of Sciences
Georgi Nadjakov Institute of Solid State Physics
72, Tzarigradsko Chaussee Blvd.,1784 Sofia, BULGARIA

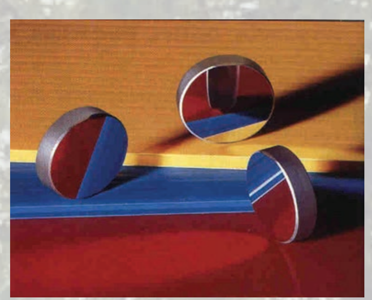
COMPETITIVE BULGARIA

LABORATORY OF OPTICS AND SPECTROSCOPY

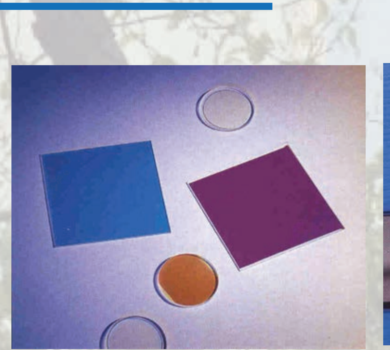
Assoc. prof. T. Tenev, Assoc. prof. R. Peyeva, Assoc. prof. K. Antonova, eng., Ph.D. I. Miloushev, Assist. prof., Ph.D. Ts. Ivanov, Assist. Prof., Ph.D. L. Yankova

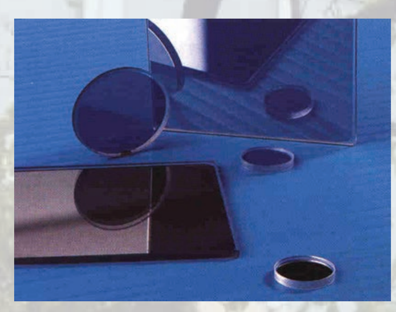
EQUIPMENT: High vacuum technology system for thin optical films deposition *Symphony 9* (Tecport Optics)

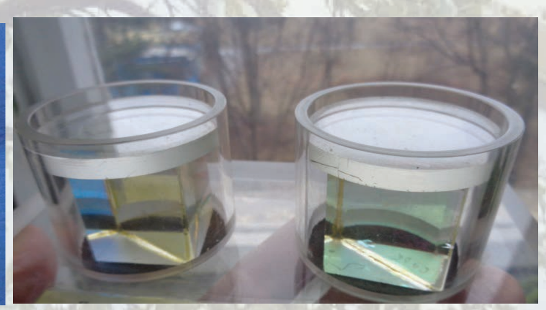
APPLICATIONS:


Mirrors


Interference filters


Short/long pass filters


AR coatings


Beamsplitters

SPECIFICATIONS:

- Chamber size 960mm diameter x 1100mm height
- Ultimate pressure 10^{-7} Torr
- Operation pressure 10^{-6} Torr in 20 min

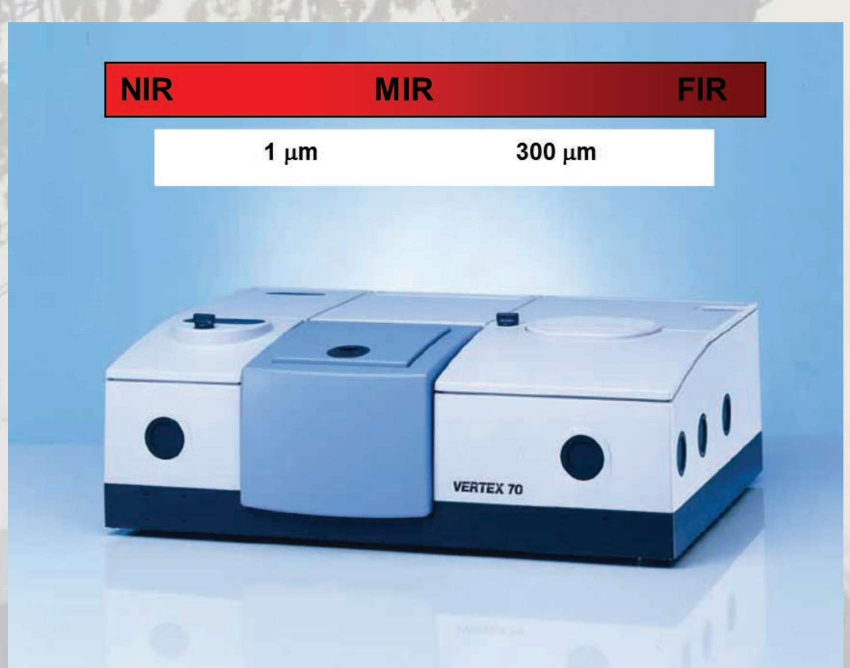
FEATURES:

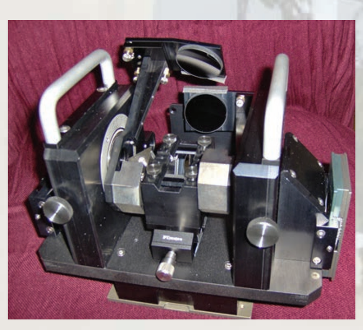
- E-beam and Resistance evaporation
- Ion-assistant deposition
- Possibility for co-deposition
- Dual-rotation planetary and single-rotation dome systems
- Thin film deposition monitoring:
  - Quartz crystal monitor
  - Direct and indirect (Intellementics) optical thickness control
- Powerful software packages:
  - Symphony OPUS Operating Software
  - Film maker and Film Director for optical monitoring

SPECTROSCOPY INSTRUMENTS:

FT-IR spectrophotometer BRUKER - Vertex 70

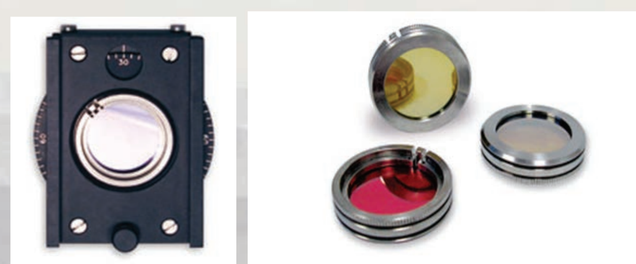
MODULES:




Spec. eflection under 13°- 83°


Diffuse eflection


Attenuated total reflection


Polarizers 0° – 360°

range	pol. degree
2–36 μм	95.8–99.7%
20–1000 μм	93%

FEATURIES:

- Transmission and Reflection spectrophotometry of solids and liquids
- Time-resolved spectrophotometry
- Electro - spectrophotometry

SPECIFICATIONS:

- Spectral range: 10 000–30 см$^{-1}$(1–300 μm)
- Spectral resolution: 0.16 см$^{-1}$
- Spectral accuracy: 0.005 см$^{-1}$
- Photometric accuracy: 0.1 %
- Signal-to-noise ratio: 10 000:1 pp

UV-VIS-NIR spectrophotometer Perkin Elmer - Lambda 1050

MODULES:


URA-reflection under 8°- 65°


150mm integration InGaAs sphere


Polarizer drive

FEATURIES:

- Wave-lenght spectrophotometry
- Time-drive spectrophotometry
- Polarization spectrophotometry

SPECIFICATIONS:

- Spectral range: 175 – 3300 nm
- UV/Vis spectral resolution: ≤ 0.05 nm
- NIR spectral resolution: ≤ 0.20 nm
- Photometric range: 8 A

Проект BG161PO003-1.2.04-0027-C0001 “Обновяване на технологично оборудване и апаратура за иновативни научно-приложни разработки на многослойни оптични стректури” с финансовата подкрепа на Оперативна програма „Развитие на конкурентоспособността на българската икономика” 2007-2013, съфинансирана от Европейския съюз чрез Европейския фонд за регионално развитие. Цялата отговорност за съдържанието се носи от Института по физика на твърдото тяло “Акад. Георги Наджаков” и при никакви обстоятелства не може да се приема, че отразява официалното становище на Европейския съюз и Договарящия орган.