NATIONAL INSTITUTE FOR LASERS, PLASMA AND RADIATION PHYSICS

« LASER – SURFACE - PLASMA INTERACTIONS » LABORATORY

ANNUAL REPORT
2007

ION N. MIHAILESCU, PROF.
LABORATORY HEAD.

1. "Laser-Surface-Plasma Interactions" Laboratory"

Staff: 22

Ion N. Mihailescu (CS I, Prof. Dr.) – Laboratory Head

Doina Craciun (CS I), Eniko Gyorgy (CS I)

Valentin Craciun (CS II)

Carmen Ristoscu (CS III), Rodica Cristescu (CS III), Gabriel Socol (CS III), Paul Serbanescu (CS III)

Gabriela Dorcioman (CS), Marimona Miroiu (CS), Emanuel Axente (CS), Sorin Grigorescu (CS), Felix Sima (CS), Nicolaie Stefan (CS)

Camelia Popescu (AC), Andrei Popescu (AC), Liviu Duta (AC)

Cristian Mihailescu (ACs), Anita Ghita (ACs)

Mirela Motoc (Drd-collaborator), Ioana Vasiliu (student-tehnician), Anton Ionita (tehnician)

PhD: 7

PhD students: 9

Permanent: 20

Collaborators: 2

A. Management of international projects

A.1 Coordinator of participations in international contracts by the National Institute for Lasers, Plasma and Radiation Physics – NILPRP Bucharest Romania:

1. ECO-NET -"Dépôts de phosphates de calcium silicatés à usage de biomatériaux" 2008-2009
2. NATO CLG 982793: "Nanocrystalline and amorphous thin films for sensor applications"; partners: Institute of Nanonostructures Technology and Analytics, University of Kassel, Germany, University of Chemical Technology and Metallurgy, Thin Films Technology Laboratory, Department of Physics, Sofia Bulgaria
3. DECHIR-CHAFILI-IB7320-111073/1: Deposition - Characterization - Irradiation of Chalcogenide Films for Lithography, 2005–2008; partners: Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland; A. F. IOFFE Physico-Technical Institute, Russia
4. EUREKA (BIONANOCOMPOSIT E!3033) 37/2005: Hydroxyapatite nanocomposite ceramics – new implant material for bone substitute, 2005–2006; coordinator: University of Riga, Latvia, **continued in 2007**
5. EUREKA (ECOSAFETY E!4141) **"**Measures for providing a quality and safety in food chain"
6. "Biosensors obtained by matrix assisted pulsed laser deposition", NATO RIG 981200
7. "Biosensors design using laser radiation", Proiect bilateral Ungaria, Universitatea "József Attila" din Szeged
8. "Thin oxide filmsgrown by laser techniques for optical sensor applications", Proiect bilateral Italia, Universitatea din Salento
9. "Development of biogenic amines optical biosensors by innovative laser nanostructuring of solid supports" Proiect bilateral Portugalia, Institutul de Chimie si Biologie din Lisabona, 2007PT0007

10. “Development of laser techniques for structuring of biomaterials” Ministerul Educatiei si Culturii, Spania, MAT2006-26534-E

A.2 Coordinator of NILPRP participation in bilateral agreements:

1. Pulsed laser deposition of oxide thin films for gas sensing and optoelectronics applications, 2006–2008; partner: Institute of Electronics, Sofia, **Bulgaria**
2. Micro- and nano-patterned surfaces and magnetic nanoparticles as a new generation in biomaterials, 2006–2007; partner: Institute of Solid State Physics, Bulgarian Academy of Sciences, Sofia, **Bulgaria**
3. Optical, magnetic and electrical properties of nanostructured layers obtained by PLD for new applications in sensing, waveguides, spintronics and advanced electrical measurements, 2004–2007; partner: Institute of Solid State Physics, Bulgarian Academy of Sciences, Sofia, **Bulgaria**
4. Nanostructured Thin Films Fabricated by Advanced Laser Techniques with Applications in Nanoelectronics, Spintronics, Biology and Medicine, Bilateral Scientific and Technological Cooperation Between **Cyprus** and Romania
5. Thin films obtained by pulsed laser deposition and matrix assisted pulsed laser evaporation, 2005-2007; partner: Institute of Physics, Academy of Sciences of the Czech Republic, **Czech Republic**
6. Réalisation par techniques laser avancées de structures multicouches biomimétiques pour la régénération des tissues minéralisés Scientific Collaboration Brancusi Program, ICSI-CNRS, Mulhouse, France, 14775SL, 2007-2008 Scientific Collaboration Brancusi Program, ICSI-CNRS, Mulhouse, **France**, 14775SL, 2007-2008
7. Mémoires tridimensionnelles a l’échelle nanométrique: stockage et lecture par des impulsions laser ultra-brèves, Scientific Collaboration Brancusi Program, LP3-CNRS, Marseille, **France**, 14813TE, 2007-2008
8. Thin films and structures for medical, chemical and biological applications, 2005–2007; 2003–2005; partner: Hebrew University of Jerusalem, Israeli Academy of Sciences and Humanism, **Israel**
9. New biomimetic calcium phosphate coatings for metallic implants; theme 36, Program of scientific and technological cooperation between **Italy** and Romania, 2006-2008
10. Laser interactions for new advanced applications in medicine, biology, and/or opto(nano)-electronics, 2006–2008; partner: Natural Sciences Center of General Physics Institute, Russian Academy of Sciences, Moscow, **Russia**
11. Laser produced plasma: spectroscopic diagnostics and applications in thin films deposition and characterizations, 2006-2008, Serbian Academy Of Sciences and arts and Physics Institute of Belgrade, **Serbia**.
12. Ultrafast electronic and structural dynamics in thin films of charge density wave compounds, Romania - **Slovenia** Cooperation In Science and Technology 2008 - 2009

B. Management of national projects

No.	CONTRACT	PERIOD, TOTAL VALUE,	VALUE 2007 INFLPR
1	CEEX 307 / 2006: Integrated technological network for biocompatible/bioactive glass powders and nanostructured thin films RETEBIOGLAS **CO – Prof. Dr. Ion N. Mihailescu**	2006 – 2008 400.000 RON INFLPR 1.500.000 RON	75.000 RON
2	CEEX 05-D11-55 / 2005: Nonlinear structures and scalability limits for quantum logics in ions traps, LOGICUANT **CO – Prof. Dr. Ion N. Mihailescu**	2005– 2008, 590.000 RON INFLPR 800.000 RON	210.000 RON (73.500 RON)
3	CEEX-06-D11-37 / 2006: Study of the quantum logics and of the quantum metrology by using electromagnetic traps. Applications in high resolution spectroscopy and environment pollution monitoring, ELECTROCUANT **CO – Prof. Dr. Ion N. Mihailescu**	2006 – 2008 985.000 RON INFLPR 1.500.000 RON	312.000 RON (109.200)
4	CEEX 60 / 2006: Targeted drug delivery by functionalized nanostructures processed by advanced pulsed laser techniques MEDINANOLAS **CO – Prof. Dr. Ion N. Mihailescu**	2006 – 2008 700.000 RON INFLPR 1.500.000 RON	155.133 RON
5	CEEX 53 / 2006: Nanostructured optical sensors for advanced gas detection SONDAG **CO – Prof. Dr. Ion N. Mihailescu**	2006 – 2008 700.000 RON INFLPR 1.400.000 RON	281.000 RON
6	EUREKA 37 / 2005: Hydroxyapatite nanocomposite ceramics – new implant material for bone substitute **Prof. Dr. Ion N. Mihailescu**	2007	150.000 RON
7	Grant 872 Chalcogenic nanostructure for high resolution advanced litography **Prof. Dr. Ion N. Mihailescu**	2007	85.000 RON
8	CEEX 150 / 2006: New laser detection techniques for biosensor manufacturing and development, BIOSENSOR	2006 – 2008 600.000 RON INFLPR 1.200.000 RON	150.000 RON

	CO – Dr. Eniko Gyorgy		
9	Grant 863: Metallic oxides multifunctional thin films with tuned optical and magnetic properties **Dr. Eniko Gyorgy**	2007	85.000 RON
10	CEEX 1428: Nanostructured thin films of aluminum nitride for advanced applications in micro- and opto-electronics, medicine and biology **Dr. Carmen Ristoscu**	2006 – 2008 144.000 RON INFLPR	72.000 RON
11	CEEX 5870: Tailoring of ultrashort laser pulses for nanostructured thin films of advanced materials **Dr. Carmen Ristoscu**	2006 – 2008 144.000 RON INFLPR	68.000 RON
12	Grant 108.2 The deposition and characterization of amorphus thin films compounds with HfO2 for high dielectric perintivity grown by combinatorial laser ablation method. **Dr. Doina Craciun**	2007-2008 200 000 RON	100.000 RON
13	PN II-IDEI 421 The Deposition of advanced transparent electrodes for solar cells using the combinatorial laser ablation method **Dr. Valentin Craciun**	2007-2010 1.000.000 RON	48.000 RON
14	CEEX 42/2005: Integrated research network of NANOMEDICINE (nano-biotehnology for health), RONANOMED P1 - **Prof. Dr. Ion N. Mihailescu**	2005-2008 103.000 RON	42.000 RON
15	CEEX 46/2005: Integrated technological network for research of biocompatible advanced structures for dental implants, RETEβDENT P1 - **Prof. Dr. Ion N. Mihailescu**	2005-2008 225.000 RON	50.000 RON
16	CEEX 69 / 2006: Research and services network for the synthesis nanostructures applications in advanced products in	2006 – 2008 200.000 RON	53.000 RON

	textile industry, protective coatings and environmental protection SINAPS ROMAT P2 - **Prof. Dr. Ion N. Mihailescu**		
17	CEEX 06-D11-63 / 2005: Optical and electronic phenomena inorganic materials with conjugated bonds for photonics applications ORGFOTON P1 - **Prof. Dr. Ion N. Mihailescu**	2005 – 2008 280.000 RON	95.000 RON
18	CEEX 05-D11-32/2005: Magnetism of clusters in interaction: fundamental processes and applications, CLUMAGIN P6- **Prof. Dr. Ion N. Mihailescu + Dr. Ing. Ion Morjan**	2005-2008 195.000 RON	65.000 RON
19	CEEX 103/ 2006: Amorphous nanostructures for smart memory/data storage devices NAMI P1 - **Prof. Dr. Ion N. Mihailescu**	2006 – 2008 450.000 RON	121.270 RON
20	CEEX 151 / 2006: Molecular mechanisms of osteoblasts adhesión differenced from STEM cells and bone tissue explants from orthopaedic biomaterials OSTEOSTEM P1 - **Prof. Dr. Ion N. Mihailescu**	2006 – 2008 300.000 RON	125.000 RON
21	CEEX 06-D11-14 / 2006: Microstucture of rare earth-doped alfa Al_2O_3 – ZrO_2 micro- and nano-systems for advanced composites - SOFC-IT), NANODOPAZ P1 - **Prof. Dr. Ion N. Mihailescu**	2006 -2008 300.000 RON	90.500 RON
22	PN II - 71-038 / 2007 Innovative technologies in view to enhance surface properties of metallic materials used in automobile production -TIMAT-AUTO P2 - **Prof. Dr. Ion N. Mihailescu**	2007-2010 210.000 RON	10.000 RON
23	PN II - 71-110 / 2007: Multilayer bioactive structures as coatings of cranio-spinal implants for enhanced biointegration -BIOSTIMP P2 - **Prof. Dr. Ion N. Mihailescu**	2007-2010	30.000 RON

24	PN II – 21-030 / 2007: Regenerable energetic convertor electrolyser-fuel cell, design and construction-CEREPC P1 - **Prof. Dr. Ion N. Mihailescu**	2007-2010 250.000 RON	30.000 RON
25	PN 01: Nanostructured thin films for advanced studies of nanolitography, nanometrical resolution 3D writing, new optical and magnetic sensors, and controlled drug delivery **CO – Prof. Dr. Ion N. Mihailescu**	2007	426.000 RON
26	PNII TD 287/Oct. 2007, "Studies of surface physics under high intensity coherent radiation: biomimetic thin films based on calcium phosphates in view of applications in medical implantology" Titular: **Marimona Miroiu** (INFLPR-Univ. Bucuresti)	15 months	41114 Lei

2. Expertise domaines:

- Laser interactions with ns and sub-ps pulses;
- Surface studies with lasers; surface processing;
- Deposition and modification of thin solid structures;
- Laser processing of thin films, nanostructured thin films technology;
- (Reactive) pulsed laser deposition (PLD/RPLD) (nitrides, carbides, metal silicides, oxides, ferrites, ferroelectrics (BST), high-k dielectrics, biomaterials, calcium phosphates, composite materials);
- Matrix assisted pulsed laser evaporation (MAPLE);
- Laser generation and characterization of nanoparticules;
- Characterization of laser ablation plasmas (OES, TOF, imaging investigations);
- Reduction of droplets emission in PLD;
- Experimental optics**;**
- Physics engineering;
- Biophysics and medical engineering, nano- and bio- technologies;
- Biomimetic metallic implants;
- Biocompatible and bioactive coatings;
- Bioglass thin films;
- Engineering Materials Science;
- Morphological, structural, optical, electrical, and mechanical characterization of thin films (FTIR, XRD, GI-XRD, SEM, TEM, AFM, XPS, X rays reflectivity,

variable angle spectroscopic ellipsometry current-voltage and capacitance-voltage measurements, nanoindentation)

- Numerical estimations of the temperature gradients in laser ablated targets;

3. Current research fields:

i) Generation and characterization of laser plasma;
ii) Laser surface studies and processing;
iii) Pulsed laser deposition, modification and characterization of nanostructured thin coatings;
iv) Nanopowders generation and characterization;
v) Nanostructured coatings for optoelectronics and sensors;
vi) Nanostructured films for gas- and bio- sensors;
vii) Biomaterial thin layers biomimetic metallic implants, tissue engineering, drug delivery);
viii) Laser transfer of delicate complex molecules of polymers and living cells by Matrix Assisted Pulsed Laser Evaporation (MAPLE);
ix) Chalcogenic materials;
x) Bioglasses
xi) Ultraviolet assisted pulsed laser deposition of thin films

4. Disemination of results :

- Articles
- Patents
- Participation to International and National Conferences

5. Equipments

A. Laser Sources:

A.1. Lambda Physics Coherent - excimer laser source, model COMPexPro 205, operational since February 2007

Main operation parameters and characteristics	
Wavelength(nm)	248
Pulse Energy (mJ)	700
Max. Rep. Rate (Hz)	50
Average Power (W)	30
Energy Stability (1 sigma) (%)	1
Pulse Duration (ns)	25
Beam Dimensions (V x H) (mm2)	24 x 6 to 12
Beam Divergence (V x H) (mrad2)	3 x 1

Dimensions (L x W x H) Laser Head	1682 x 375 x793 mm3 (67 x 15 x 31 in.3)
Vacuum Pump	530 x 230 x240 mm3 (21 x 9 x 9 in.3)
Water Cooling	2 to 3 l/min. (0.5 to 0.8 gal./min.), 15 to 20°C, connection: ½²

Main Features

- Energy monitor with output stabilization· Smooth ceramic preionization for unmatched pulse-to-pulse stability
- Advanced internal gas purification system for extended operation of laser gas and tube windows
- NovaTube metal-ceramic tube technology
- Magnetic-Assist (MA) protection for extended thyratron lifetime
- Small footprint· Single-phase operation

(1-Measured at low repetition rate, 2-Measured at max. repetition rate, 3-Typical, FWHM, 4-Only required above 20 Hz repetition rate)
Note: The system can also operate at 193, 308 or 351 nm.
A.2. M 1071 KrF* excimer laser source (λ=248 nm, τFWHM $\geq$ 7 ns) operating at a repetition rate of maximum 20 Hz. Energy per pulse $\leq$ 150 mJ.

B. Deposition Chambers and Accessories

B.1. Stainless steel high vacuum chamber, with Cu gaskets or viton O-rings with vacuum performances of up to 10-8 Pa

- 45.72 cm diameter
- 4 CF 150 flanges (for heater, target, substrate and vacuum pump)
- 2 CF 50 ports for laser beam access in the chamber
- 4 CF 35 flanges for gauges and lateral view
- 3 CF16 flanges for gas valve, evacuation valve, and Pirani probe
- gas flowing controller MKS
- high vacuum pumping system Pfeifer
- carrousel type system with 5 target holders

B.2. Stainless steel vacuum chamber

- 42 cm diameter
- temperature controller, model Eurotherm 2146, t_{max} = 12000 C
- preliminary Rotary SD 2033D vacuum pump
- high vacuum pumping system (vacuum system with turbomolecular high capacity pump, Alcatel ATP 400) P_{min}= 10^{-6} Pa
- 3 gauges measuring the pressure inside the chamber
- gas flowing controller MKS50
- carrousel type system with 5 target holders

C. Target Preparation and Sample Preservation:

C.1. TALASI SAFETY CABINET - with centrifugal exhauster VSB 20

MAIN PARAMETERS	
Maximum capacity (mc/h)	950
Noise (db)	>62
Piping vent (mm)	200
EQUIPMENT	electric control panel
	2 meshes 220V – 16A
	table: fireproof laminated plastic, ceramic plates, stainless steel AISI 304 – 316, polypropylene, granite stone
	centrifugal exhauster VSB 20

Vertical laminar airflow cabinet BSC-EN I – II

Characteristics:

- Class II protection cabinet EN-12469
- vertical laminar flow-
- stainless steel AISI 304 walls and workspace

Model	**BSC-EN 1-3**
Int. dims (Lxhxl) (mm)	885 x 660 x 580
Ext.dims (Lxhxl) (mm)	1090 x 1470 x 780
Power (kW)	0,7
Opening (mm)	200
Temperature variation (°C)	<4
Electrical supply (Hz)	220 V/50
Noise (dBA)	< 59
Lighting (lux)	> 1.000
Vibrations	<0,005 mm rms

Accessories

UV Lamp
Charcoal evacuation filter
Supplementary outlet
Anti-blowback valve

C.2. High purity water system TKA Pacific UP/UPW6

Typical applications are:
- Rinsing of glassware
- Preparing or diluting buffers, reagents, tissue culture media, and stains
- Preparing samples for relatively undemanding analytical methods such as flame AAS

Performance
- Flow rate (at 15 ^oC): 6 L/h
- Retention of bacteria and particles: 99%

TKA GenPure Ultra Pure Water System accessory with UV-intensity and TOC monitoring – reducing very low organic/inorganic contaminant concentrations in high-purity feedwater even further by UV photo-oxidation at 185 and 254 nm irradiation wavelengths

Ultra pure water quality:
- Conductivity: 0.055 µS/cm
- Bacterial content: 1 CFU/ml
- TOC 1: 10 ppb
- Pyrogen free

C.3. Retsch centrifugal ball mill (Type S 100)

Suitable for batch grinding (wet or dry) of medium hard, hard and brittle, hard and tough and fibrous materials

Dimensions (mm)	Height: up to approx. 420 mm; Width: 350 mm; Depth:510 mm with cover open; Height: up to approx. 630 mm; Width: 350 mm; Depth: 510 mm
Speed of grinding jars (min^{-1})	**400** - with grinding jar type "S" standard 500 ml special steel and 7 grinding balls, 30 mm diameter in tungsten carbide **500** - with grinding jar type "S" standard 250 ml tungsten carbide and 5 grinding balls 30 mm diameter in tungsten carbide **580 max** - with grinding jar type "S" standard 50 ml tungsten carbide and 3 grinding balls 20 mm diameter in

	tungsten carbide
Rated power (W)	approx. 100
IP rating	IP40/IP20 vessel to casing
Rated speed of motor (cm^{-1})	2500

C.4. Velp Scientifica Vortex Wizard agitator

Two operation mVodes:
- SENSOR - automatically activates the stirring when the test tube enters the interception field of an incorporated optical system
- CONTINUOUS enables uninterrupted work with different accessories

Features
- Infrared motion detector to activate agitation in a "no-touch" mode
- Microprocessor control of ramping speed (from 0 to 3000 rpm)
- High protection class IP 42
- Orbital diameter 4.5 mm

C.4. Universal furnace from Carbolite (Model CWF 1100)

MAIN PARAMETERS	
Model CWF (volume)	13 liters
Max Temp (°C)	1100
Max Power (watts)	3100
Holding Power (watts)	1300
Nominal Heat Up Time (min)	55
Temperature Sensor	Type K thermocouple

The furnace makes it possible to:

- sintering of targets used in PLD/RPLD experiments;
- powder and targets calcinations;
- annealing of samples and multistructures;
- multifunctional thermal treatments.

The furnace is equipped with a special retort for treatments in ambient gases (O_2, N_2, inert gases)

C.5. Binder Microbiological Incubator (Heating oven, Drying oven)

Incubator: because of the precise temperature accuracy, is especially useful for incubation of cultures at standard temperature of 370^0C.

Heating and drying oven: for drying and heat treatment of solid or pulverized materials, as well as bulk material

Temperature data	
Temperature range (± 0C), 50^0C above ambient to	300
Temperature variation (± 0C) at 700^0C	0.8
at 1500^0C	2
at 3000^0C	3.7
Temperature fluctuation (± 0C)	0.3
Heating up time (min) to700^0C	7
to 1500^0C	22
to 2500^0C	45

EQUIPMENT	Microprocessor temperature controller with LED display, timer function and ramp function
	Temperature safety device cl.2 acc. To DIN 12880 - 1
	Exhaust duct f 50mm with ventilation slide
	Rolling feeds with brake

C.6. Vilber Lourmat UV lamp

Power and versatility
Lamp-emitted radiation centered around 312 nm White light filter
Key features: Reflector for optimum UV irradiance: Lamp stand or holder to add versatility

Model	Tube(W)	Wavelength(nm)	Intensity at 15 cm (μW/cm2)
VL-115 M	1x15	312	1000

D. Characterization on place:

D.1 Cintra 10e Spectrophotometer

Our Cintra 10e spectrophotometer is suited to routine lab work in most application areas, and has true double beam, high efficiency, all-reflective optics, the full complement of automated accessories and the power of the fully-integrated Spectral software package. It has a fixed 1.5 nm slit width and a silicon photo-diode detector, covering an extended wavelength range of 190 to 1,200 nm.

The DRS 1150 reflectance sphere allows reflectance measurements up to 1150 nm in a standard UV-Vis.

D.2. Optical microscope NU2

Illumination: Hg lamp (HBO 200), Xe lamp (HBO 101), Halogen lamp
Magnification: 8 – 25 X object size
Operation mode:

Transmission	bright field - with plan-chromatic condenser
	bright field – without condenser
	dark field
	phase contrast
	fluorescence
	polarized light
	polarization microscopy
Reflection	bright field
	dark field
	phase contrast
	polarized light
	fluorescence
Transmission + Reflection	

D.3. FTIR Fourier Transform of Infrared Spectroscopy, Schimadzu

Interferometer	Michelson interferometer (30° incident angle) Dynamic alignment system Sealed and desiccated interferometer
Optical system	Single beam optics
Beam splitter	Germanium-coated KBr plate
Beam source	Ceramic
Detector	High sensitivity pyroelectric detector (DLATGS)
Wavenumber range	7800 cm^{-1} -350 cm^{-1}
Resolution	0.85 cm^{-1} ,1 cm^{-1} ,2 cm^{-1} ,4 cm^{-1} ,8 cm^{-1} , 16 cm^{-1}
Calculation wavenumber interval [1]	0.25 cm^{-1} ,0.5 cm^{-1} ,1 cm^{-1} ,2 cm^{-1} ,4 cm^{-1}

Wavenumber accuracy [1,2]	±0.25 cm^{-1}
S/N ratio	20000:1(Peak-to peak,resolution 4 cm^{-1}, approx.2100 cm^{-1},1minute scanning)
Mirror speed	3-stept selection from 2.8 mm/sec, 5mm/sec,or 9 mm/sec A scanning at 4 cm^{-1} takes from 2-3 sec
Data sampling	He-Ne laser
Gain control	Automatic or manual from x1-x128 in 2^n steps
Sample compartment	200(W)x230(L)x170(H) mm
Dimensions/weight Spectrophotometer unit	620(W)x580(L)x240(H)mm,40kg

1. FTIR spectrophotometer resolution and wavenumber accuracy are determined by the spectral data wavenumber range. The FTIR-8400S minimum calculated wavenumber is 0.25 cm^{-1}. The peak position can be read with an accuracy of ±0.215 cm^{-1}. However, the accuracy is decreased by the asymmetric absorption bands up to ±0.5 cm^{-1}

6. Scientific papers published in international journals

1. “Biocompatible and bioactive coatings of Mn2+ doped β-tricalcium phosphate synthesized by pulsed laser deposition”, F. Sima, G. Socol, E. Axente, I.N. Mihailescu, L. Zdrentu, S.M. Petrescu, I. Mayer, accepted for publication in Applied Surface Science, Applied Surface Science, **254(4),** 1155-1159 (2007)

I F: 1.436

2. “Synthesis of functionally graded bioactive glass - apatite multistructures on Ti substrates by pulsed laser deposition”, D. Tanaskovic, B. Jokic, G. Socol, A. Popescu, I. Mihailescu, R. Petrovic, Dj. Janackovic, Applied Surface Science, Applied Surface Science, **254** (4) 1279-1282 (2007)

I F: 1.436

3. “Study of the gradual interface between hydroxyapatite thin films PLD grown onto Ti-controlled sublayers”, S.Grigorescu, A. Carradò, C.Ulhaq, J.Faerber, C.Ristoscu, G.Dorcioman, E.Axente, J. Werckmann, I.N.Mihailescu, Applied Surface Science, **254**, 1150-1154 (2007).

I F: 1.436

4. "Structural and optical characterization of undoped, doped, and clustered ZnO thin films obtained by PLD for gas sensing applications" C. Ristoscu, D. Caiteanu, G. Prodan, G. Socol, S. Grigorescu, E. Axente, N.

Stefan, V. Ciupina, G. Aldica, I. N. Mihailescu, Applied Surface Science (253), 15 (2007), 6499 - 6503

I F: 1.436

5. "Nanoscopic photodeposited structures analyzed by an evanescent optical method" G. Socol, E. Axente, M. Oane, L. Voicu, A. Petris , V. Vlad, I. N. Mihailescu Presented at International Conference ICPEPA 5 Charlottesville, September 2006, Applied Surface Science, 253 (2007), 6535–6538

I F: 1.436

6. "Polycaprolactone Biopolymer Thin Films Obtained by Matrix Assisted Pulsed Laser Evaporation" R. Cristescu, A. Doraiswamy, G. Socol, S. Grigorescu, E. Axente, F. Sima, R. J. Narayan, D. Mihaiescu, A. Moldovan, I. Stamatin, I. N. Mihailescu, B. J. Chisholm, D. B. Chrisey, Applied Surface Science, 253 (2007), 6476–6479

I F: 1.436

7. "Matrix Assisted Pulsed Laser Evaporation of Poly(D,L-Lactide) Thin Films for Controlled-Release Drug Systems" R. Cristescu, A. Doraiswamy, T. Patz, G. Socol, S. Grigorescu, E. Axente, F. Sima, R.J. Narayan, D. Mihaiescu, A. Moldovan, I. Stamatin, I.N. Mihailescu, B. J. Chislom, D.B. Chrisey, Applied Surface Science, 253(19), (2007) 7702–7706

I F: 1.436

8. "Nanocrystalline Er:YAG thin films prepared by pulsed laser deposition: an electron microscopy study" Daniela Stanoi, Andrei Popescu, Corneliu Ghica, Gabriel Socol, Emanuel Axente, Carmen Ristoscu, I. N. Mihailescu, Andrea Stefan, Serban Georgescu, Applied Surface Science 253 (2007), 8268–8272

I F: 1.436

9. "Matrix Assisted Pulsed Laser Evaporation of Cinnamate- and Tosylate-Pullulan Polysaccharide Derivative Thin Films for Pharmaceutical Applications M Jelinek, R Cristescu, E. Axente, T Kocourek, J Dybal, J Remsa, J Plestil, D. Mihaiescu, M. Albulescu, T. Buruiana, I. Stamatin, I N Mihailescu, D B Chrisey, Applied Surface Science, 253(19), (2007) 7755-7760

I F: 1.436

10. "Influence of in situ nitrogen pressure on crystallization of pulsed laser deposited AlN films", S. Bakalova, A. Szekeres, A. Cziraki, C.P. Lungu, S. Grigorescu, G. Socol, E. Axente, I.N. Mihailescu, Applied Surface Science 253 (19) (2007) 8215 – 8219

I F: 1.436

11. “Bioactive glass and hydroxyapatite thin films obtained by pulsed laser deposition” E. Gyorgy, S. Grigorescu, G. Socol, I. N. Mihailescu, A. Figueras, D. Janackovic, E. Palcevskis, L. E. Zdrentu, S. Petrescu, Applied Surface Science (19), 253 (2007) 7981 – 7986

I F: 1.436

12. "Laser Processing of DOPA modified PEG Mussel Adhesive Protein Analog Thin Films", A. Doraiswamy, R.J. Narayan, C. Dinu, R. Cristescu, P.B. Messersmith, S. Stafslien, D.B. Chrisey, Journal of Adhesion Science & Technology, 21(3-4), (2007) 287-299(13)

I F: 0.868

13. "Enhanced gas sensing of Au nanocluster –doped or –coated zinc oxide thin films", G. Socol, E. Axente, C. Ristoscu, F. Sima, A. Popescu, N. Stefan, L. Escoubas, J. Ferreira, S. Bakalova, A. Szekeres, I. N. Mihailescu, Journal of Applied Physics, 102, 1, 2007

I F: 2.316

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I F: 1.106

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7. Patents

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This patent was awarded with:

Gold Medal at 5th International Exhibition of Innovations, New Ideas, Products, and Technologies, Arca 2007, Zagreb, Croatia, September 11-16, 2007
Bronze Medal at 11th International Exhibition of Inventions, Scientific Research and New Technologies, Inventika 2007, October 2-6, 2007, Bucharest, Romania

8. Lucrari ne-citate ISI

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9. Lucrari in Proceedings ISI

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10. Membership

<u>Ion N. Mihailescu</u>

Membership of Professional Societies

- Optical Society of America since 1986
- European Physical Society (Quantum Electronic Division) since 1984
- Romanian Physical Society since 1983
- International Society of Optical Engineering (SPIE) since 1983

International Journals/Contracts

- Invited referee: Langmuir (since 2008), International Journal of Materials and Product Technology (since 2007), Journal Of Physics : Conference Series (since 2007), Advanced Engineering Materials (since 2006); Applied Physics A (since 2005); Journal of Biomedical Materials Research (since 2005); Journal of Applied Physics (since 2003); Surface Coatings and Technology (2001); Applied Surface Science (since 2001); Optical Engineering (since 1995); Thin Solid Films (since1991).
- International Board Member: Digest Journal of Nanomaterials and Biostructures (since 2006), Opto-Electronics Review (since 2000); Journal of Optoelectronics and Advanced Materials (since 1999); Revue des Technologies Avancées (since 1980).
- Evaluator of National (MEC, CNCSIS) and International (EU, NATO) Contracts since 2000.

International Conference Organizing

- Co-director of NATO-Advanced Study Institute "Functionalized Nanoscale Materials, Devices, and Systems for chem.-bio Sensors, Photonics, and Energy Generation and Storage" Sinaia, Romania, June 4-15, 2007;

<u>Eniko Gyorgy</u>

Membership of Professional Societies

- Member of PhD Corporation, Hungarian Academy of Science

Expert Reviewer of projects:

- Ministry of Education and Research – CEEX, CNCSIS, CNMP – PNCDII - projects,
- FP VI Projects, Bruxelles
- Ministry of Education and Research, Hungary

Journal reviewer

- Applied Surface Science
- Journal of Materials Science
- Materials Science and Engineering B
- Solid State Communications
- Materials Letters

- Journal of Optoelectronics and Advanced Materials
- Journal of Physics D: Applied Physics
- Surface and Coatings Technology
- Sensors and Actuators B
- The Journal of Physical Chemistry
- Journal of Physics: Condensed Matter
- Europhysics Letters
- Materials Chemistry and Physics
- Optics and Laser Technology

Valentin Craciun

Professional societies

• MRS
E-MRS
• SPIE, the Society of Photo-Optical Instrumentation Engineers – 2004-present, http://www.spie.org

Journal reviewer

• Surface and Coatings Technology
• Material Science & Engineering: C
• Journal of Optoelectronics & Advanced Materials
• Thin Solid Films
• Applied Surface Science
JAP
APL

Carmen Ristoscu

Referee for international Journals:

- Thin Solid Films
- Journal of Electrochemical Society
- Applied Surface Science

Rodica Cristescu:

Professional societies

• Sigma Xi, the Honor Scientific Research Society – 2005-present, http://www.sigmaxi.org
• Ad-Astra, the Romanian Scientific Community On-Line – 2005-present, http://www.ad-astra.ro
• SPIE, the Society of Photo-Optical Instrumentation Engineers – 2004-present, http://www.spie.org

Journal reviewer

• Surface and Coatings Technology
• Journal of Biomedical Optics

- Physica Status Solidi
- Material Science & Engineering: C
- Journal of Optoelectronics & Advanced Materials
- Thin Solid Films
- Applied Surface Science

MAIN PROJECTS RESULTS IN 2007

RETEBIOGLAS 307/2006

- Functionally graded multistructures of HAP and BG layers were deposited by PLD in water vapors and low pressure oxygen, respectively, onto Ti substrates.
    - The introduction of BG interlayers led to a considerable increase in multistructure adherence to the substrate and improved the crystallinity of the HAP overcoating.
    - FTIR showed that no significant changes in the activity of the main functional groups of HA were induced by PLD transfer.
    - The surface morphology of every coating consisted of adjacent spherical droplets of micron dimensions with high density of particulates, expected to enhance cell growth and proliferation.
    - We tested in SBF solution thin films obtained by PLD from bioglasses with 57 wt % and 61 wt % SiO_2 content.
    - 6P57 sample with smaller concentration of silica has higher solubility and bioactivity than the 6P61 films.
    - A continuous layer of carbonated apatite was growing in SBF on the 6P57 coatings surface as result of ions exchange with the SBF medium, whereas coatings with higher silica content (6P61) were more resistant to corrosion and slower in apatite formation. The biological apatite was in the latter case organized in islands onto the films surface.
    - Human osteoblasts cultured on bioglass thin films for three days evidenced adhesion contacts between large surfaces of the cells and the bioglass films, pointing that the deposited coatings represent proper substrates for proliferation and survival.

    - Both types of bioglass thin films are biocompatible and represent suitable materials for further research in view to obtain biomimetic metallic implants coated with glasses.

MEDINANOLAS 60/2006

- Powders of biocompatible PEG polymers and their derivatives (carboxyl, amine,), MPEG-co-PCL-co-MPEG and PEG-co-PCL copolymers, and polyvinil alcohol derivative (APVCOOH)) have been synthesized, characterized and selected by preliminary biocompatibility tests.
- Cryogenic targets have been obtained using proper solvents and subsequently processed by MAPLE.
- Thin films and structures collected onto Si substrates have been further characterized by FTIR Spectroscopy and AFM.
    - The most important result has been reached in case of APVCOOH at relative small fluences (300 mJ/cm^2) when both besides material MAPLE-

transfer with no chemical degradation and chained globular morphology with a large distribution of pores with (1 - 10) nm have been obtained.

- In this case we identified the best posible compromise between laser processing parameters and thin film structural characteristics in terms of porosity and similar composition with those of he starting material.
- Further investigations are related with drug release dynamics tests *in vitro*, cytotoxicity tests *in vitro*, pharmacodynamics tests will evidence specific action, comparative studies on coated and uncoated drug agents.

PUBLISHED RESULTS:

1. „*Functionalized polyethyleneglycol derivatives thin films synthesized by matrix-assisted pulsed laser evaporation*" R. Cristescu, C. Cojanu, A. Popescu, G. Socol, D. Mihaiescu, G. Caraene, R. Albulescu, T. Buruiana, I Stamatin, I.N. Mihailescu, D.B. Chrisey, E-MRS' 07, Strasbourg, Franta, 28 Mai – 03 June 2007
2. „*Processing of Poly(1,3-bis-(p-Carboxyphenoxy Propane)-co-(Sebacic Anhydride)20 : 80 (P(CPP : SA)20 : 80) by Matrix-Assisted Pulsed Laser Evaporation for Drug Delivery Systems*" R. Cristescu, C. Cojanu, A. Popescu, S. Grigorescu, C. Nastase, F. Nastase, Doraiswamy, R.J Narayan, A. Ionescu, O.S.Ionescu (Serbanescu), I. Stamatin, I.N. Mihailescu, and D.B. Chrisey, Applied Surface Science 254 (2007) 1169–1173.
3. "*Synthesis and characteristics of poly(ethylene glicol) derivatives for deposition by matrix assisted pulsed laser evaporation*", Tinca Buruiana, Emil C. Buruiana, Lenuta Hahui, Mirela Zamfir, Rodica Cristescu, Ion N. Mihailescu, European Polymer Congress 2007, Portoroz, 2-6 July, Slovenia
4. "*Chemically modified polyethylene glycol and sol-gel derived hybrid composites for bioapplications*", Emil C. Buruiana, Tinca Buruiana, Mihaela Olaru, Lenuta Hahui, Rodica Cristescu, I. N. Mihailescu, Al 41-lea Congres IUPAC, Torino 5-11 August 2007, Italia
5. "*Materiaux nanoporeaux par sol-gel based dessus'l alcool polyvinylique*", Mihaela Olaru, Emil C. Buruiana, Bogdan C. Simionescu, Rodica Cristescu et Ioan N. Mihailescu, Colocviul Franco-Roman, Grenoble, August 2007..
6. "*Functionalized Polyvinyl Alcohol Derivatives Thin Films for Controlled Drug Release and Targeting Systems: Laser Deposition and Morphological, Chemical and In Vitro Characterization*"
Rodica Cristescu, Camelia Cojanu, Andrei Popescu, Sorin Grigorescu, Liviu Duta, Georgeta Caraene, Alexandru Ionescu, Dan Mihaiescu, Radu Albulescu, Tinca Buruiana, Adriana Andronie, Ioan Stamatin, Ion N. Mihailescu, Douglas B. Chrisey, submitted la EMRS '08, Strasbourg, 26-30 May 2008.
7. "*Laser Processing of Polyethylene Glycol Block Copolymers Thin Films*"
Rodica Cristescu, Camelia Cojanu, Andrei Popescu, Sorin Grigorescu, Liviu Duta, Oana-Salomeea Ionescu, Dan Mihaiescu, Tinca Buruiana, Adriana Andronie, Ioan Stamatin, Ion N. Mihailescu, Douglas B. Chrisey, submitted EMRS '08, Strasbourg, 26-30 May 2008.

SONDAG 53/2005

In this project, a new structure of gas sensor based on optical principles is designed and developed. The pulsed laser deposition technique (PLD) is applied to obtain high quality light guides of metallic oxides as ZnO, TiO_2, SnO_2, and WO_3. Catalysts such as noble metals (Pt, Pd, Au, Ag) are used for doping or clustering, in order to enhance and increase the optical response, respectively, the selectivity to a certain gas. The structures were preliminary optically interrogated by a home made m-line setup which proved the reliability of detection. At the end of the contract a functional Mach-Zehnder sensor prototype will be developed.

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1. "*Structural and optical characterization of undoped, doped, and clustered ZnO thin films obtained by PLD for gas sensing applications*", C. Ristoscu, D. Caiteanu, G. Prodan, G. Socol, S. Grigorescu, E. Axente, N. Stefan, V. Ciupina, G. Aldica, I. N. Mihailescu, APPLIED SURFACE SCIENCE, Volume: 253, Issue: 15, Special Issue: SI, Pages: 6499-6503, (2007)

2. "*Enhanced gas sensing of Au nanocluster-doped or -coated zinc oxide thin films*", G. Socol, E. Axente, C. Ristoscu, F. Sima, A. Popescu, N. Stefan, I. N. Mihailescu, L. Escoubas, J. Ferreira, S. Bakalova, A. Szekeres, JOURNAL OF APPLIED PHYSICS, Volume: 102, Article Number: 083103, (2007)

3. "*Nickel oxide thin films synthesized by reactive pulsed laser deposition: characterization and application to hydrogen sensing*", I. Fasaki, A. Giannoudakos, M. Stamataki, M. Kompitsas, E. Gyorgy, I.N. Mihailescu, F. Roubani-Kalantzopoulou, A. Lagoyannis, S. Harissopulos, Appl. Phys. A, DOI: 10.1007/s00339-008-4435-0, (2008)

BIOSENSOR CEEX 150/2006

- Creatinine and urease thin films were synthesized by matrix assisted pulsed laser evaporation (MAPLE) techniques for enzyme-based biosensor applications. (An UV KrF* (λ=248 nm, τ~20 ns) excimer laser source was used for the irradiation of the targets at incident fluence values in the (0.2-0.5) J/cm^2 range)
- The concentration of the aqueous solution was in the range of (5-10) %.
- The surface morphology, chemical composition and crystal structure of the obtained biomaterial thin films were investigated by SEM, FTIR, and electron dispersive X-ray spectroscopy as a function of the target preparation procedure and incident laser fluence.
- The urease enzymatic activity and kinetics were studied using the Worthington assay method. MAPLE deposited thin films were immersed in blank solutions prepared and mixed with urea in potassium phosphate buffer.
  - The suitable experimental conditions were found, frozen composites of 10 wt. % urease solvent and 0.4 J/cm^2 incident laser fluence, which lead to deposition of

uniform thin films, with chemical composition and molecular structure identical to those of the starting biomaterial used for the target preparation.

- The kinetics analyses were performed by measuring the variation of the solution absorbance at 340 nm over one hour period.

o The fast absorbance variation and the increase of the absorbance variation with the increase of the incubation time indicate that the laser immobilised enzyme was active in breaking down urea.

The obtained results were valorized as follows:

1. *"Creatinine biomaterial thin films grown by laser techniques"*

E. Gyorgy, E. Axente, I. N. Mihailescu, D. Predoi, S. Ciuca, J. Neamtu

Accepted for publication in Journal of Materials Science: Materials in Medicine

2. *"Immobilization of urease by laser techniques: synthesis and application to urea biosensors"*

E. Gyorgy, F. Sima, I. N. Mihailescu, T. Smausz, G. Megyeri, R. Kékesi, B. Hopp, L. Zdrentu, S. M. Petrescu

Accepted for publication in Journal of Biomedical Materials Research

3. *"Biomolecular urease thin films grown by laser techniques for blood diagnostic applications"*

E. Gyorgy, F. Sima, I. N. Mihailescu, T. Smausz, B. Hopp, D. Predoi, S. Ciuca, L. E. Zdrentu, S. Petrescu

Submitted for publication in Sensor Letters

4. **"***Laser deposition of active urease thin films"*

T. Smausz, G. Megyeri, R. Kékesi, Cs. Vass, E. György, F. Sima, I. N. Mihailescu, B. Hopp

Submitted for publication in Applied Physics A: Materials Science and Processing

RO-NANOMED – 42/2005

- Thin films of manganese-doped b-tricalcium phosphate were deposited by PLD on chemically etched Ti substrates.
  - o Films were stoichiometric (Ca/P ~ 1.50 – 1.52, EDX), in a mostly amorphous, poorly crystalline phase (GI-XRD), rather homogeneous molding the rough relief of the chemically etched Ti substrate (SEM).
  - o None of the tested materials was cytotoxic, since both of them induced cell adherence and growth over a period of 14 days in culture.
  - o The samples of 0.2Mn-doped b-TCP showed higher potential for proliferation and better viability when tested in osteoprogenitor cell culture than did those with a lower Mn content.

- In addition, the parallel pattern of actin filaments in 0.2Mn-doped b-TCP showed that this biomaterial interacted better with the MSCs than did 0.1Mn-doped b-TCP.

1. ”*Biocompatible and bioactive coatings of Mn2+-doped b-tricalcium phosphate synthesized by pulsed laser deposition”*
F. Sima, G. Socol, E. Axente, I.N. Mihailescu, L. Zdrentu, S.M. Petrescu, I. Mayer
Applied Surface Science 254 (2007) 1155–1159

OSTEOSTEM – 151/2006

- Ce-stabilized ZrO2-doped HA thin films were deposited by PLD onto porous Al2O3 substrates with average pore size in nanometer region, manufactured from nanosized powder.
  - The stoichiometric (EDS) coatings showed nanostructured surface morphologies with micronic droplets (AFM, SEM< TEM).
  - The mesenchymal stem cells (MSC) seeded with for in vitro tests showed good attachment and spreading, they covered uniformly the entire surface of the samples.
  - Depending on substrate porosity, systematic and repetitive differences were observed in the efficiency of developing long filopodia and achieving optimal intracellular organization.
  - First analysis indicates that thin film grown on the substrate sintered at 1400ºC has shown a better potential of interaction with the MSCs.

1**.** *Synthesis of functionally graded bioactive glass - apatite multistructures on Ti substrates by pulsed laser deposition*

D. Tanaskovic, B. Jokic, G. Socol, A. Popescu, I. Mihailescu, R. Petrovic, Dj. Janackovic

Submited to Applied Surface Science

2. *Biomimetic glass coatings for advanced metallic implants obtained by pulsed laser deposition* A. Popescu, C. Ristoscu, F. Sima, G. Socol, G. Dorcioman, I. N. Mihailescu, L. Zdrentu, S. Petrescu, V. Simon, S. Simon, C. Ducu, C. Sutan, D. Tanaskovic, Dj. Janackovic

Presented to FLAMN conference Rusia

RETEβDENT CEEX 46 / 2005

- A synthetic organic polymer (maleic anhydride-vinyl acetate copolymer) is added to the hydroxyapatite HA ($Ca_{10}(OH)_2\ (PO_4)_6$), the main component of the bone tissues, in order to obtain biomimetic composite coatings for metallic medical implants. The polymer is *thought/designed* to induce surface functionalization and to enhance the mechanical properties (elasticity).
- Maleic anhydride- copolymer thin films and composite hydroxyapatite-copolymer thin films, respectively, were deposited by MAPLE and tested as biological properties, as well as hydroxyapatite coatings grown by PLD.
    - In vitro analysis of cytoskeleton, nuclei and cell viability tests demonstrated that cells adhered and proliferated on HA-NaM surfaces.
    - The proliferation rate indicated that polymer enhances the coating biocompatibility properties as compared to the HA-coated samples.
        - "*Biocompatibility evaluation of a novel hydroxyapatite-polymer coating for medical implants (in vitro tests)"*, G.Negroiu, R.M. Piticescu, G.C. Chitanu, I.N. Mihailescu, L. Zdrentu, M.Miroiu, Journal of Materials Science: Materials in Medicine, 19 (4) 2008 1537-1544