

**Dezvoltare dispozitive optice micro si nano-structurate pentru
procesarea optica a informatiei
DOMINO**

Contract: **135 CEEEX II 03 INFOSOC /2006**

Coordonator: IMT Bucuresti

Director de proiect: Dr.ing. Dana Cristea

Buget proiect: **1434000** lei

Perioada de derulare: octombrie 2006-august 2008

Adresa web: www.imt.ro/domino

Consortiu

- **Institutul National de Cercetare - Dezvoltare pentru Microtehnologie (IMT Bucuresti) - Laboratorul de Micro si Nano Fotonica** - coordonator
- str. Erou Iancu Nicolae nr.32B, sector 2, Bucuresti, tel. 021 4908412, fax: 021 4908238
- **PRO OPTICA S.A.**
str. Gh. Petraşcu nr. 67, Bucuresti, tel. fax 324 49 84/ 324 43 12
- **Institutul National pentru Laseri, Fizica Plasmei si Radiatiilor, Laboratorul de Interferometrie Laser**
- str. Atomistilor nr.409, Bucuresti-Magurele, tel. 021 4574489, fax: 021 4574243
- **Universitatea Politehnica Bucuresti – Centrul de Cercetare in Optoelectronica (UPB-CCO)** Spl. Independentei 313, sector 6, Bucuresti, tel./fax: 021 4024801
- **Institutul National pentru Cercetare - dezvoltare in Stiinte Biologice**
Splaiul Independentei nr. 296, Bucuresti, tel. 2207780, fax 2207695

Nr. crt.	Denumirea indicatorului	Nr. de indicatori planificati	Nr. de indicatori realizați
1	Studii	5	6
2	Proiecte	3	5
3	Prototipuri		
4	Tehnologii - ME	1	1 tehnologie
5	Produse informatice		
6	Alți indicatori specifici programului		
	- numar de sisteme/structuri realizate/aplicate/implementate	2 structuri	3 (faza 4) +3 (faza 5)
	- numar de servicii noi/modernizate/aliniate/aplicate/ valorificate		
7	Articole publicate in tara	1	2
8	Articole publicate in strainatate	1	2
9	Brevete propuse/acceptate	-	
10	Carti publicate in tara	-	2
11	Carti publicate in strainatate		
12	Comunicari stiintifice	3	18
13	Propuneri de proiecte transmise la programe internationale cu tematica rezultata din proiectul derulat	1	1
14	Propuneri de proiecte internationale aprobate cu tematica rezultata din proiectul derulat		1

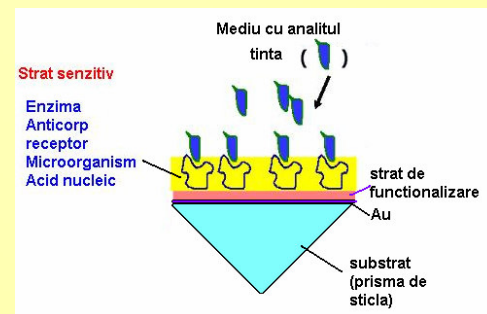
Simpozionul *"Rezultatele cercetarii romanesti in domeniul tehnologiilor informationale si de comunicatii obtinute în cadrul Programului CEEX - Modulul 1"*, Iunie 2008

Indicatori suplimentari

Nr. crt.	Denumirea indicatorului	Nr. de indicatori planificati	Nr. de indicatori realizați
1	procese tehnologice elaborate	4	2 variante de procese litografice, 1 proces replicare, 2 procese realizare str. sensitive
2	metode de caracterizare elaborate	3	metoda de caracterizarea microlentilelor/retelelor de microlentile ca sisteme formatoare de imagine (masurarea OTF) metode de caracterizare a formei suprafetei microlentilelor (prin metoda interferometrica si prin metoda microscopiei confocale cu scanare laser) 2 metode experimentale de caracterizare a componentelor si sistemelor microoptice: scatterometria, microscopia interferentiala, 4 metode teoretice aplicate la analiza datelor experimentale ale scatterometriei: Teoria Riguroasa de Unde Cuplate (RCWA), Analiza Modala, metoda Chandezon a schimbarii de coordonate si Teoria Mediului Efectiv (EMT)
3	participari la retele de laboratoare;	2	•4M- NoE FP6 (cluster micro-optics) •ASSEMIC- RTN FP6
4	cursuri de instruire \ perfectionare	1	1 program master, 1 program doctorat
5	manifestati stiintifice organizate	4	7: CAS-3 editii, ATOM-N : 2 editii INDLAS- 2 editii, ASSEMC WS
6	Activitati in cadrul grupurilor de lucru ale PT Photonics 21		4 (2 annual meetings, 2 WG6 workshops)

Studii

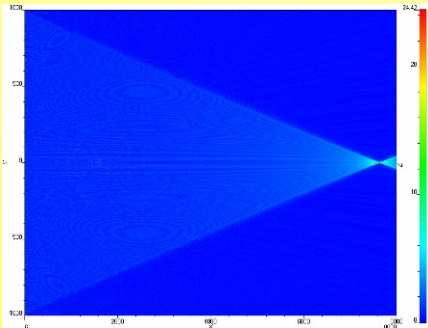
- **Studii privind tehnici de avansate de caracterizare componente si sisteme micro-optice:**
 - tehnici de caracterizare a microlentilelor si a retelelor de microlentile (P2)
 - caracterizarea spectrofotometrica specifica sistemelor microoptice(P2)
 - sisteme integrate de caracterizare/masurare a micro si nano opticii (P2)
 - tehnici de caracterizare componente micro-optice bazate pe scaterometrie si microscopie interferentiala(P3)
- **Studii privind utilizarea componentelor micro-optice in biologie**
- **Studii experimentale materiale sensitive pentru senzori biofotonici**
- **Studii privind tehnici de avansate de caracterizare componente si sisteme micro-optice : 4 tehnici de microscopie interferentiala si aplicate la caracterizarea componentelor optice nanostructurate (3 tehnici de tip microscopie optica si una pur interferometrica).**



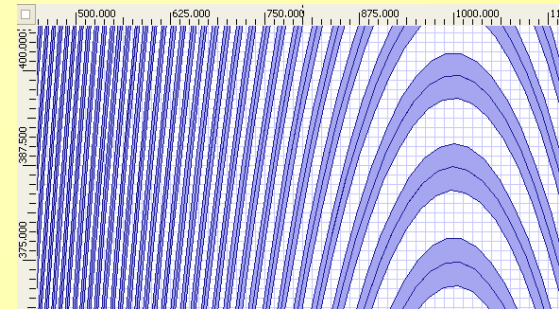
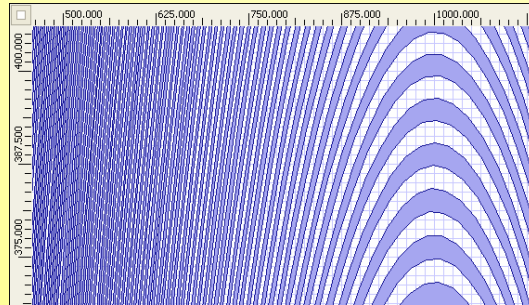
Proiecte

- **elemente optice difractive**

- a) Lentila Fresnel cu 2 si respectiv 4 nivele discrete a fost proiectata utilizand programul software OptiBPM.
- b) element optic difractiv complex cu dimensiunea de $1024 \mu\text{m} \times 1024 \mu\text{m}$ si cu latura pixelului de $1 \mu\text{m}$. care permite reconstructia la infinit a logo-ului „IMT-Bucuresti” utilizand programul software 3Lith..
- c) polarizori pentru laseri cu CO₂ pe baza de retele de difracție metalice dreptunghiulare. S-au obtinut trei variante de structura care asigura obtinerea unor coeficienti de extincție foarte mari, un output maxim acceptabil și sunt prin transmisie la incidență normală.



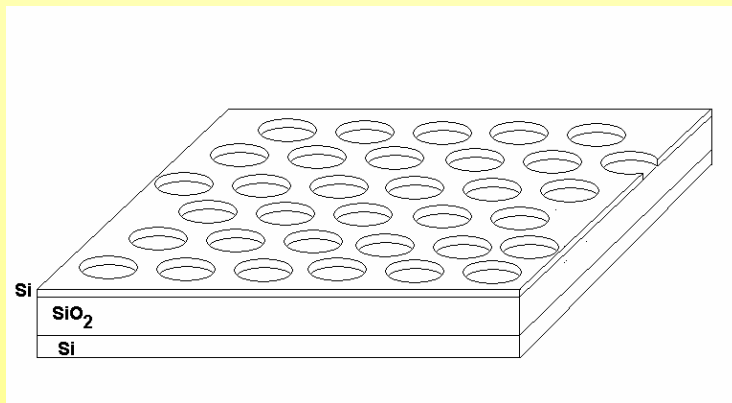
Propagarea radiatiei printr-o lentila Fresnel cu 4 nivele



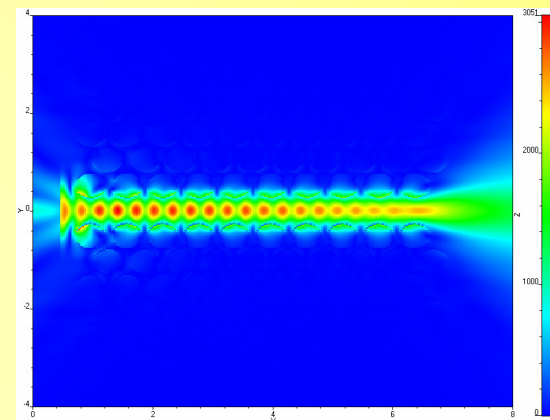
Masti pentru realizare lentile fresnel cu 4 nivele (2 masti necesare)

Proiecte

- **cristal fonic din structura SOI**, de simetrie hexagonala



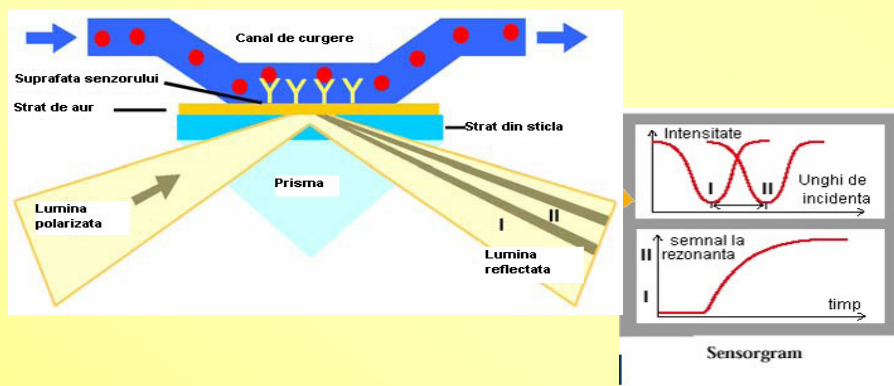
Cristalul fonic configurat in structura tip SOI



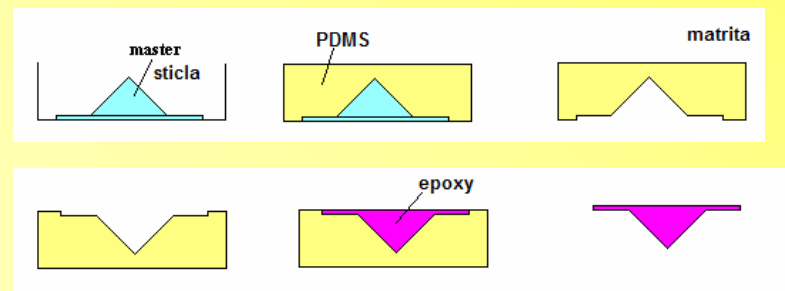
Propagarea radiatiei intr-un ghid de unda din cristal fonic cu structura hexagonala

Proiecte

- Biosenzor optic pe baza de SPR**

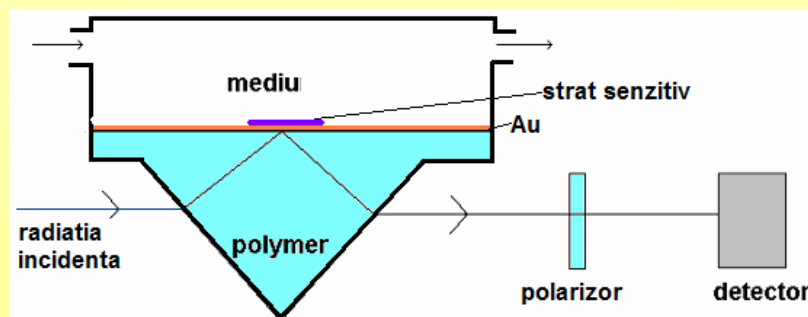


Structura



Procesul de realizare a prisme din rasina epoxidica

Montaj caracterizare

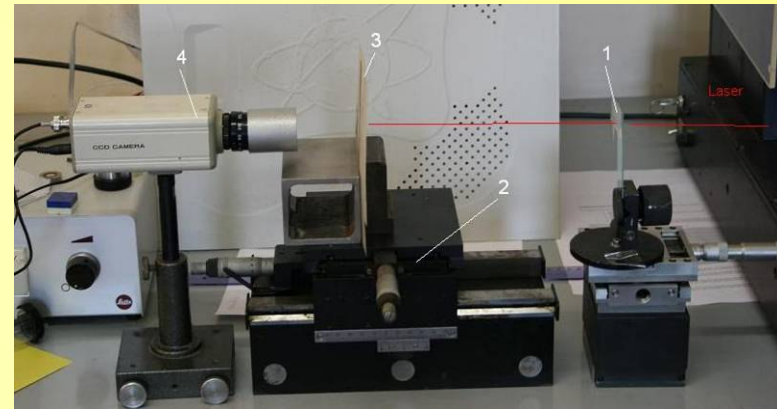


Montaje caracterizare- exemple

- **montaje experimentale pt. caracterizarea functionala a structurilor**
- montaje si proceduri de caracterizarea dimensionala (pas, latime linie, adancime, uniformitatea pasului) si functionala (unghi si eficienta de difractie) a elementelor optice difractive.



Montaj optic pentru masurarea traseabila a pasului elementelor optice difractive



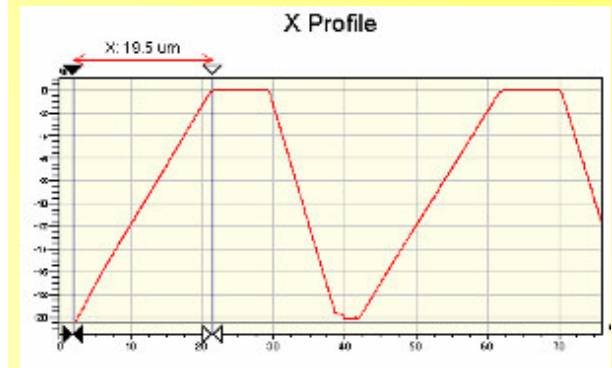
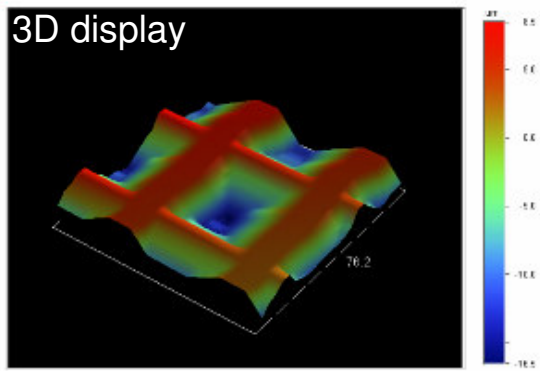
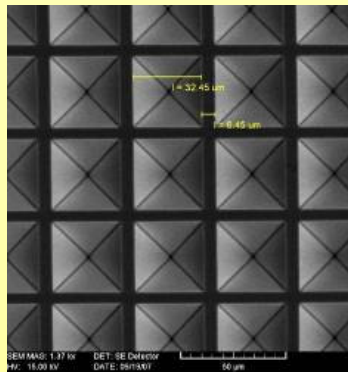
Montajul pentru observarea si inregistrarea imaginilor de difractie obtinute cu diferite structuri: 1.Structura de microelemente optice analizata; 2.Masa cu deplasare controlabila; 3. Ecran difuzant; 4.Camera TV cu obiectiv

Structuri: Elemente optice difractive (DOE) piramidale si cu profil dreptunghiular

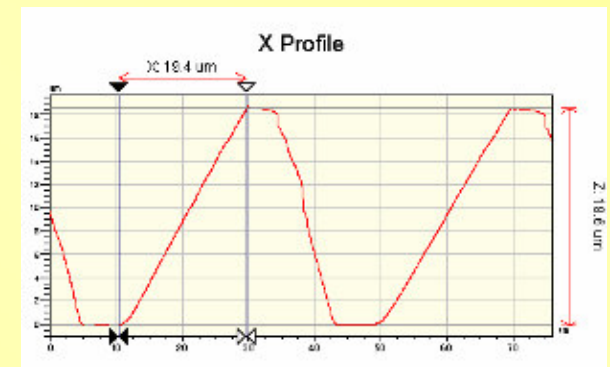
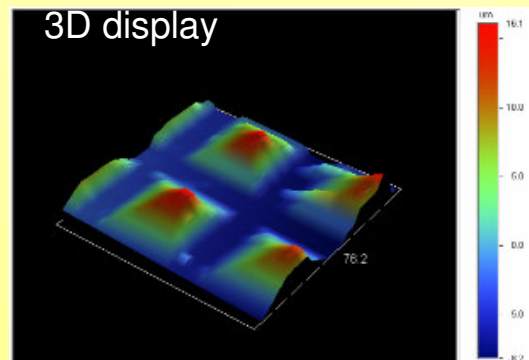
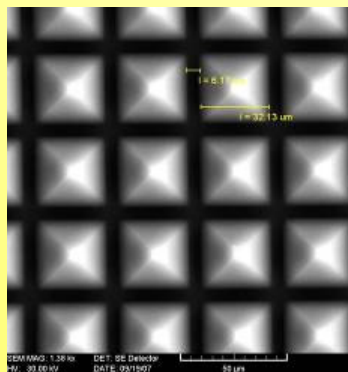
SEM images

Profilometry

matrita



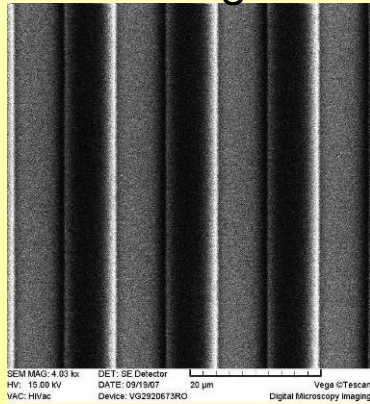
replica



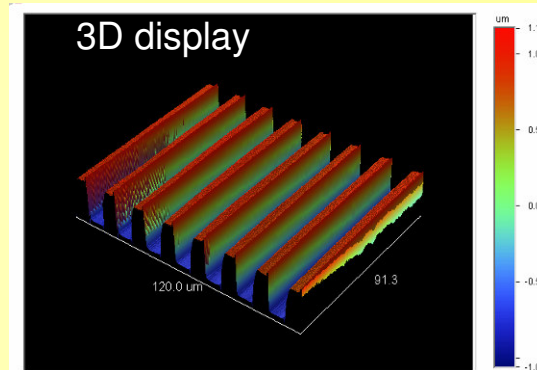
Structuri: *rețele de difracție*

matrita

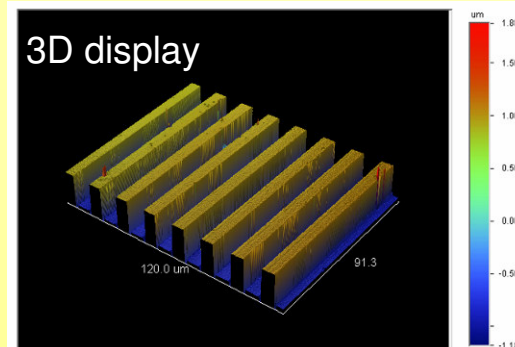
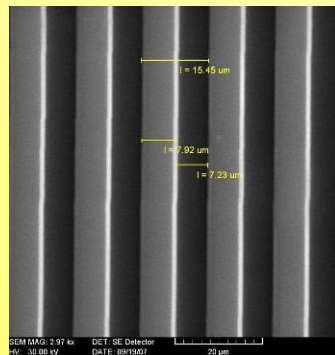
SEM images



Profilometry



replica



Lucrari stiintifice

Carti

- Ovidiu Iancu, Ionica Cristea, Neculai Grosu, *Procesoare Fotonice*, Editura MATRIX ROM, Bucuresti 2007, ISBN 978-973-755-214-3;
- Ovidiu Iancu, Ionica Cristea, Neculai Grosu, *Dispozitive optoelectronice-Indrumar de laborator*, Editura MATRIX ROM, Bucuresti 2007 (in print)

Articole

- Mihai Kusko and Dana Cristea “*Theoretical and numerical analysis of the microring resonator refractometers*”, Proc. SPIE Vol. **6635**, **Advanced Topics in Optoelectronics, Microelectronics and Nanotechnologies**, (2007) p.663504(8 pagini)
- Virginia Maduta, Danut Ursu, Georgeta Sorohan, Constantin Vlada “*Influence of surface initial status in optical glass polishing with submicron polishing powders*”, **Sc.and Tech. Bull. Of the Aurel Vlaicu Univ. Arad, Mech. Eng.**, Vol 3. 2007
- Paula Obreja, Dana Cristea, Mihai Kusko and Adrian Dinescu ***Polymer-based chips for surface plasmon resonance sensors***, **J. Opt. A: Pure Appl. Opt.** **10** (2008) 064010 (6pp) doi: 10.1088/1464-4258/10/6/064010
- Alina Butu, Averina Nicolae, Manuela Elisabeta Sidoroff : The use of Micro-optical components in Biology , trimis spre publicare in revista: *Romanian Biological Sciences*

Comunicari stiintifice

1. D. Cristea, P.Schiopu, Advanced program for education and training activities in photonics in Romania – co-operation between research and academic centres, **Proc. of the Symposium on Photonic Technologies for Framework Programme 7**, 11-15 octombrie 2006, Wroclaw, Polonia
2. Petre C. Logofătu*, Dan Apostol, Victor Damian, Florin Garoi, Iuliana M. Iordache, Mihaela M. Bojan, Ludmila Serghei and Adrian Sima "Enhancements of the Abelés method for refractive index determination- **ATOM-N 2006**, Bucuresti, nov. 2006.
3. Cristian Kusko and Mihai Kusko, "Left handed electromagnetism in a metallo dielectric structure", **First European Topical Meeting on Nanophotonics and Metamaterials, Nanometa 2007**, Seefeld, Austria, 8 – 11 January, 2007
4. Mihaela Bojan, Iuliana Iordache, Stefania Florea , F. Garoi, A. Sima, Dana Cristea, A. Dinescu, Raluca Muller "White light interferometry for height artifact calibration specimen", **Young Optician School**, Erevan, Armenia, 2-7 mai 2007
5. Cristian Kusko, "Left handed electromagnetism in a three-dimensional dielectric structure", **Symposium "Nano and Giga in Europe: Communicating at the global level"**, 25 mai 2007, Romanian Academy Bucharest
6. Cristian Kusko and Mihai Kusko, "Left handed electromagnetism in a composite dielectric structure", **Third International Conference on Surface Plasmon Photonics**, Dijon, France, 17 - 22 June, 2007
7. M.Kusko, A.Kapsalis, C.Kusko, D. Alexandropoulos, D.Cristea, D.Syvridis, Design of single-mode vertically coupled microring resonators, **2nd European Optical Society Topical Meeting:" OPTICAL MICROSYSTEMS** Capri (Napoli), Italia, 30 September – 3 October 2007, Book of Abstracts, p. 72.
8. D. Cristea, P.Obreja, A.Dinescu, E.Manea, D.Apostol Simple replication technique for low cost diffractive optical elements, autori: D.Cristea, **2nd European Optical Society Topical Meeting:" OPTICAL MICROSYSTEMS "** Capri (Napoli), Italia, 30 September – 3 October 2007, Book of Abstracts, p. 96.
9. D. Cristea, P. Obreja, A. Dinescu, M.Kusko, D. Apostol , Fabrication technique for polymer-based diffractive optical elements, **EOS Topical Meeting on Diffractive Optics**, 20-23 November 2007, Barcelona, Spain.
10. C. Kusko and M. Kusko, "Terahertz effective magnetic activity in microstructured TiO₂; a numerical study", **Proc. of International Semiconductor Conference - CAS 2007, October 15-17, 2007, Sinaia, Romania**, pp. 181-184.
11. D.Apostol, P.C.Logofatu, R.Muller, "Nano-Metrology between necessity and reality", Proc. of **International Semiconductor Conference - CAS 2007**, October 15-17, 2007, Sinaia, Romania, pp. 381-384.
12. O.Iancu, P.Schiopu, A.Manea, I.Cristea, N.Grosu, "Laser Characterization of the periodic Line – Space Micro / Nano Structures", Proceedings of The 30 th **International Seminar on Electronics Technology 2007, ISSE 2007**, Cluj-Napoca, pp188-196, ISBN 978-973-713-174-3
13. Danut URSU, **Georgeta SOROHAN**, Virginia MADUTA, "*Equipment for MTF of sampling imaging optical systems measuring*" The 32nd **International Scientific Conference of the Military Technical Academy**, 1-2 noiembrie 2007
14. Danut URSU, Magdalena TANTU, Georgeta SOROHAN, Virginia MADUTA "*Characterization of nanometric topography surfaces*", **The 32nd International Scientific Conference of the Military Technical Academy**, 1-2 noiembrie 2007.
15. D. Cristea, P.Obreja, M. Kusko, M. Purica, A. Dinescu, A. Herrero, Dan Apostol, E. Manea, Fabrication of polymer micro-optical components for integration in silicon MOEMS, Photonics Europe 2008 – Strasbourg, Franta, 6-10 aprilie 2008
16. V. Damian , Mihaela Bojan, P. Schiopu, Errors affecting white light interferometry thickness measurement , **International Conference - INDLAS - Second Edition 2008 "MODERN LASER APPLICATIONS"** May 20-23, 2008, Bran, Romania
17. Petre Catalin Logofatu, Adrian Sima, Bogdan Ionita, Iuliana Iordache, Dan Apostol, The characterization of gratings using the optical scatterometer, **International Conference - INDLAS - Second Edition 2008 "MODERN "**
18. M. Bojan, White light interferometry for height artifact calibration specimen.3 rd **International Polidh Student Chapter Meeting** , 7-10 mai 2008, Wroclaw, Polonia:

Simpozionul "Rezultatele cercetarii romanesti in domeniul tehnologiilor informationale si de comunicatii obtinute in cadrul Programului CEEX - Modulul 1" , Iunie 2008

Manifestari stiintifice organizate

- **Cooperation in industry-oriented research in an enlarged Europe: „Info- and brokerage event in new technologies and materials (FP7/2007: NMP/ICT)”,** Chamber of Commerce and Industry of Romania, in Bucharest, 22-23 March 2007, "George Assan" Hall, wing IV, 1st floor
- **ASSEMIC Info Day** May 13, 2007
- MINOS-EURONET SCIENTIFIC AND BROKERAGE EVENT: *Scientific workshop: “Microsystems as a platform for integrating micro/nano/biotechnologies”*, *Info- and brokerage event: Micro- and nanosystems call in FP7/2007*, Bucharest, Romania, 23-25 May 2007
- sesiuni „Micro-optics and Microphotonics” in cadrul **Annual International Semiconductor Conference- CAS 2006 (sept. 2006)**, CAS 2007 (October 15-17, 2007, Sinaia, Romania, **CAS 2008** (in curs de organizare)
- **SPIE Symp. Advanced Topics on Optoelectronics, Micro-and Nanotechnologies- ATOM-N 2006 si 2008** (in curs de organizare)

Participarea in FP7:

Flexible Patterning of Complex Micro Optical Structures using Adaptive Embossing Technology – FlexPAET, proiect integrat, trimis la call-ul si acceptat pentru finantare – perioada (2008-2011).

- IMT este partener (D. Cristea responsabil de WP si membru in Steering Committee).