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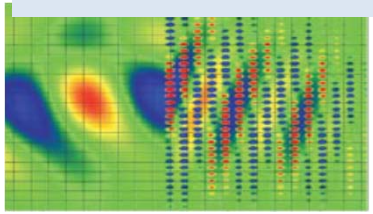
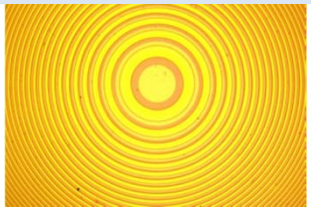
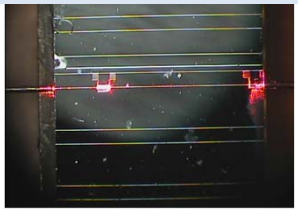
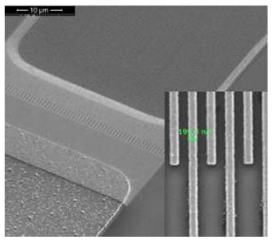
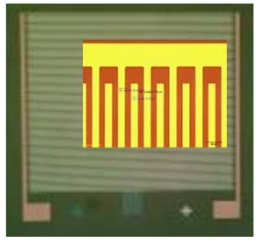
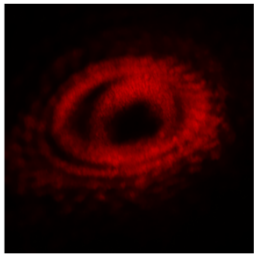
„Parteneriat în exploatarea Tehnologiilor Generice Esențiale (TGE) utilizând o PLATformă de interacțiune cu întreprinderile competitive” (TGE-PLAT)”

"Rezultate obținute în cadrul proiectelor IMT pentru direcția "Fotonică"”

Laboratorul de Micro- si Nanofotonică

Sef Laborator: Dr. Dana Cristea

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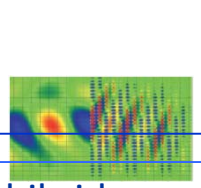
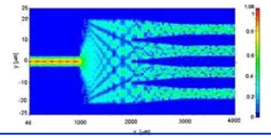
Domenii de cercetare

Modelare, simulare, CAD structuri micro si nano-fotonice

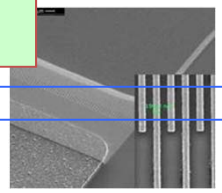
- Dispozitive si circuite integrate optoelectronice
- Circuite fotonice integrate
- Componente de microoptica si elemente optice difractive
- OMEMS

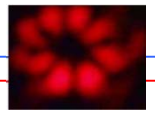
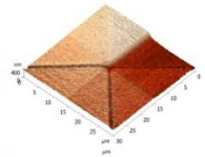
Caracterizari optice si electrice pentru materiale si dispozitive

Noi materiale pentru micro-si nano-fotonica (nanocompozite hibride cu proprietati optice controlate, oxizi semiconductori transparenti, grafena, puncte cuantice)**, noi procese si dezvoltare de dispozitive**

Materiale → **Procese** → **Dispozitive**



Componente micro-nano-fotonice: componente microoptice, DOE, structuri plasmonice, componente si circuite de optica integrata

Directii noi

- **optoelectronica organica (incluzand si dispozitive pe baza de nanocompozite grafena-polimer)**
- **electronica transparenta**
- **metasuprafete plamonice**

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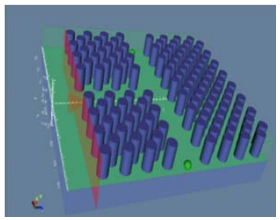
Facilitati

Modelare si simulare:

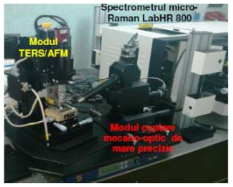
- ***Opti FDTD 12.2.1*** – proiectare, modelare, simulare, CAD a componentelor fotonice pasive si neliniare prin metoda FDTD (Finite-Difference Time-Domain)
- ***OptiBPM 11.0*** - proiectare, modelare, simulare, CAD a ghidurilor optice si a circuitelor fotonice integrate complexe prin metoda BPM (beam propagation method).
- ***OptiGrating ,*** **LaserMod**
- **3Lit** – design pentru elemente micro-optice 3D.
- **Zemax** –design optic.



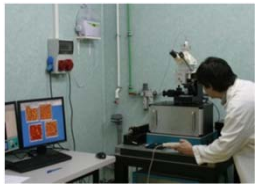
Tehnologie

- glove box pentru prepararea si depunerea nanocompozitelor si straturilor organice

Caracterizare:



- ***Spectrofotometre*** *pentru domeniul UV-VIS-NIR si IR;*
- ***Elipsometru spectroscopic***
- ***Sistem complex*** *rezultat prin cuplarea* ***modulului TERS/AFM*** *la* ***spectrometrul micro-Raman – LabHR 800*** *pentru analiza nanostructurilor carbonice si oxidice (nanotuburi, nano/micro fire, grafene,nanocompozite*).
- ***Alpha300 S System*** *–*microscopie de baleiaj in camp apropiat (SNOM), microscopie confocala , microscopie de forta atomica, spectrometrie Raman
- ***Tensiometru Optic*** *Theta (KSW Instruments)*
- *Montaj experimental pentru caracterizarea optoelectrica a dispozitivelor in UV-Vis-NIR*



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Rezultate (selectie)

- *Componete micro/nano-optice difractive*
- *Fotodetectoare*

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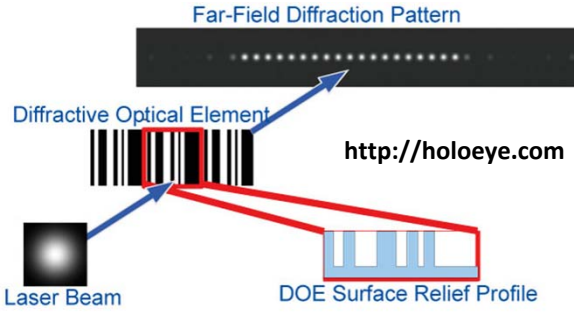
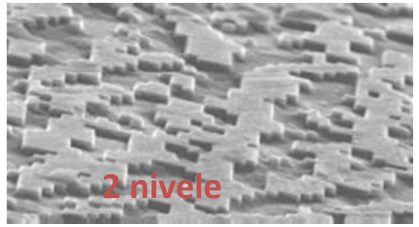
Micro-optica difractiva

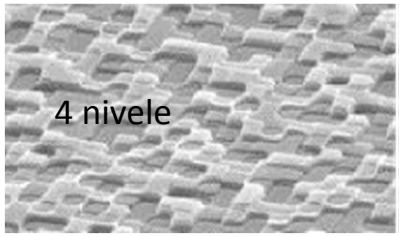
Elementele optice difractive (DOE) sunt suprafete cu structuri micro/nano-optice complexe cu ajutorul carora se manipuleaza radiatia laser incidenta in scopul implementarii functiei optice dorite utilizand fenomenul de difractie.

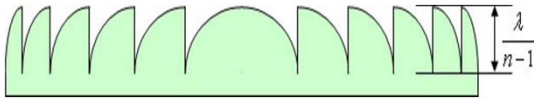
- Suprafata de difractie a unui DOE consta dintr-o retea de elemente optice micro sau nanostructurate care si prezinta o variatie locala 2D a perioadei si o variatie 3D a reliefului.
- Variatia reliefului – in trepte (structuri binare sau multinivel) sau continua
- DOE permit practic obtinerea oricarei distributii de intensitate a fasciculului emergent

- **Aplicatii:** componente pentru comunicatii optice (elemete de cuplaj, splitere, beam shaping, wave front generators, etc.), procesarea materialelor cu laserul, spectroscopie, senzori, elemente de securitate, sisteme de iluminat.









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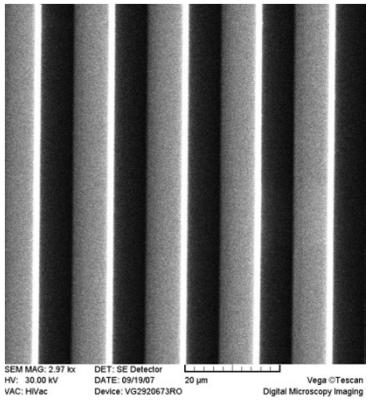
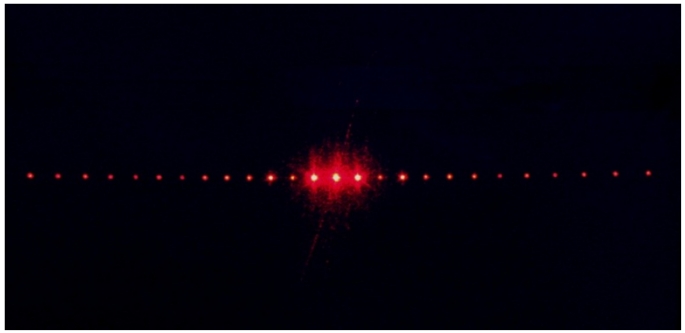
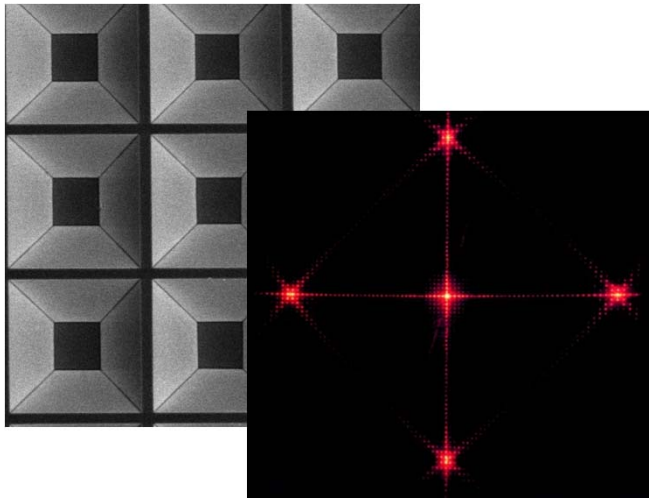
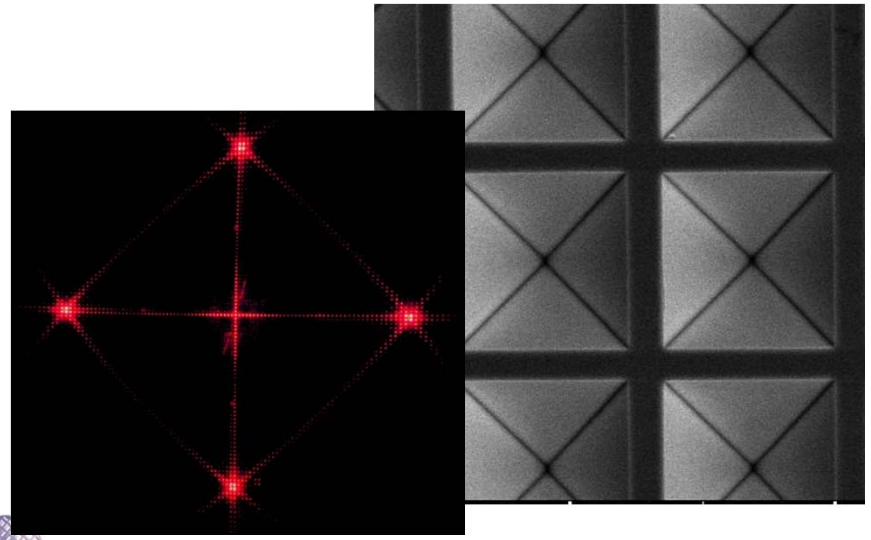
Micro-optica difractiva









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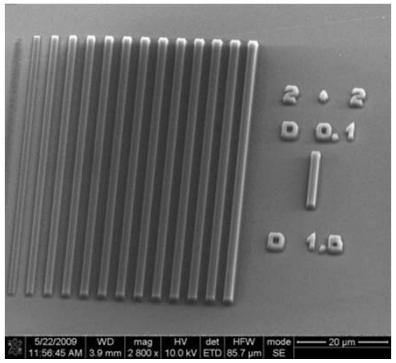
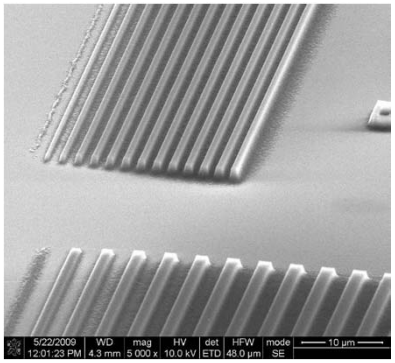
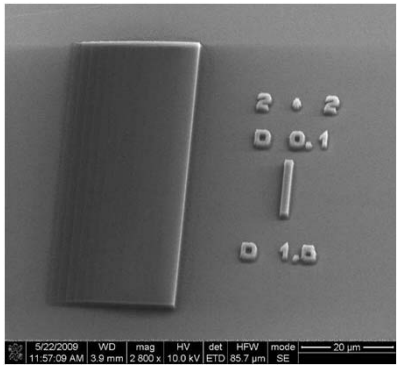
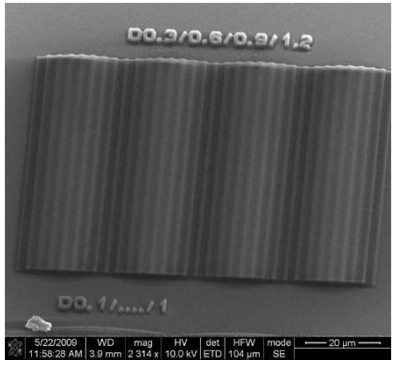
Micro-optica difractiva- Tehnologii

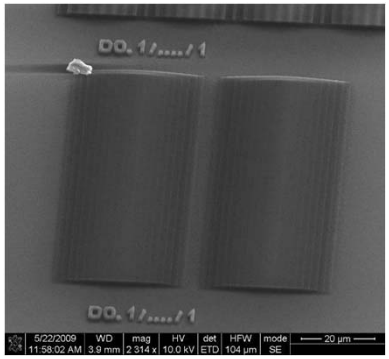
- **Litografie 3D in rezisti cu contrast redus - SU 8**

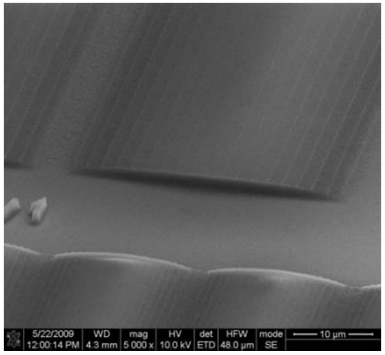












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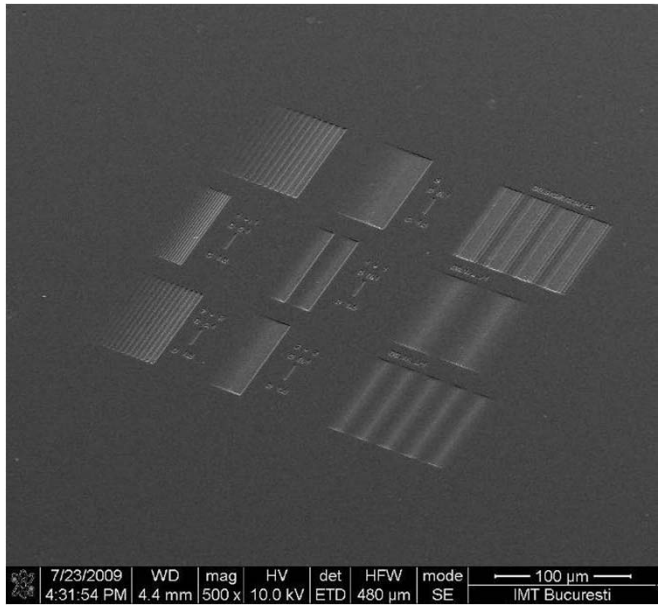
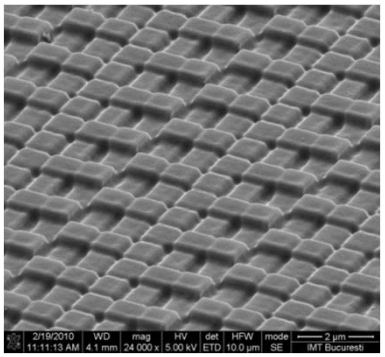
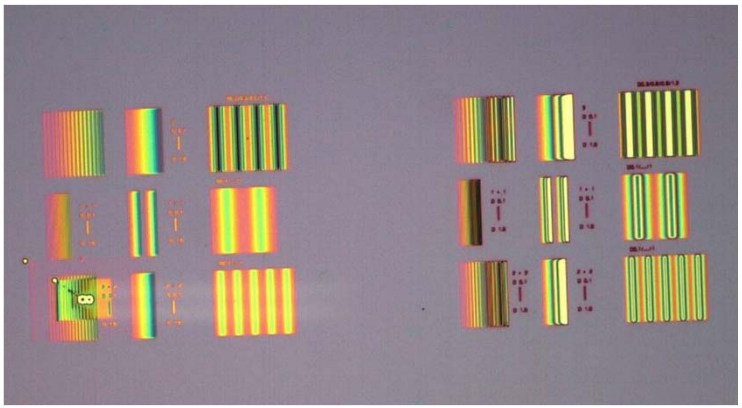
Micro-optica difractiva - Tehnologii

- **Litografie 3D in rezisti cu contrast redus - PMMA**







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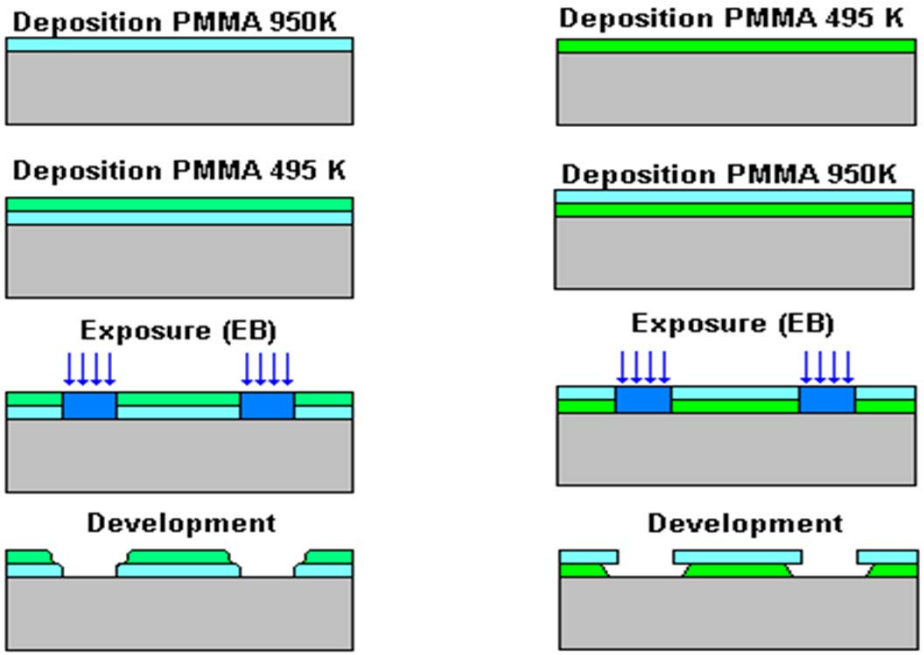
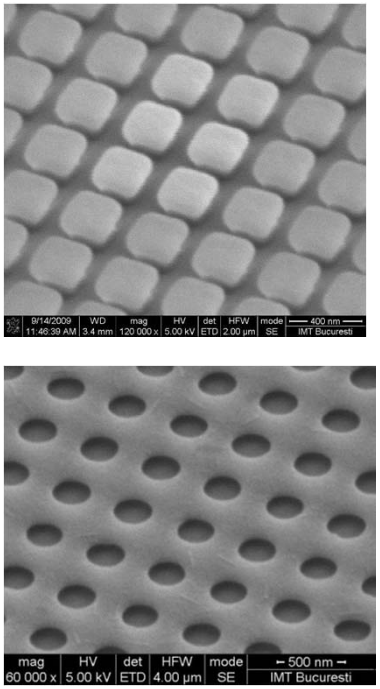
Micro-optica difractiva- Tehnologii

- **Litografie 3D in straturi duble de rezisti**





2 rezisti cu rate de developare diferite

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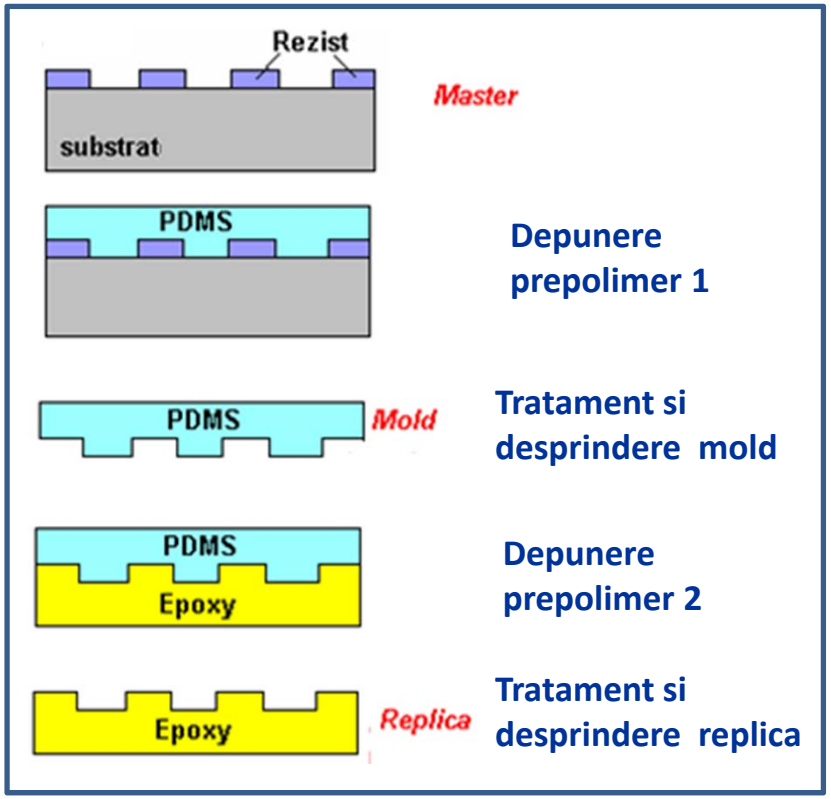
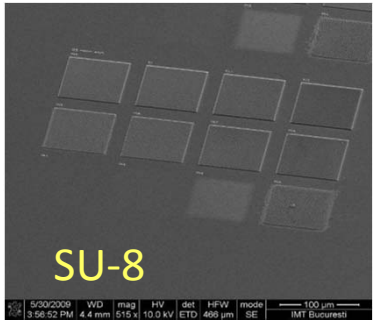
Micro-optica difractiva- Tehnologii

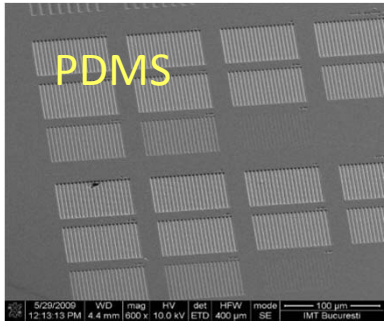
- **Replicare a unor mastere cu profil 2D/3D**



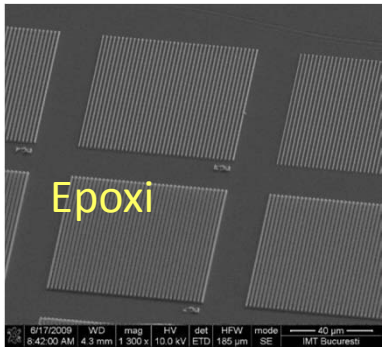
original



copie negativa



copie pozitiva



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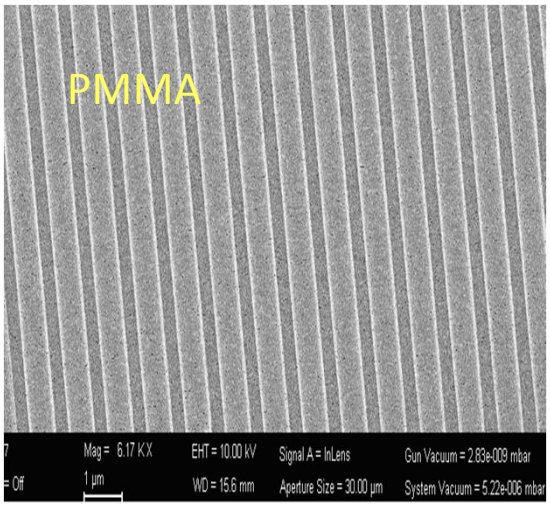
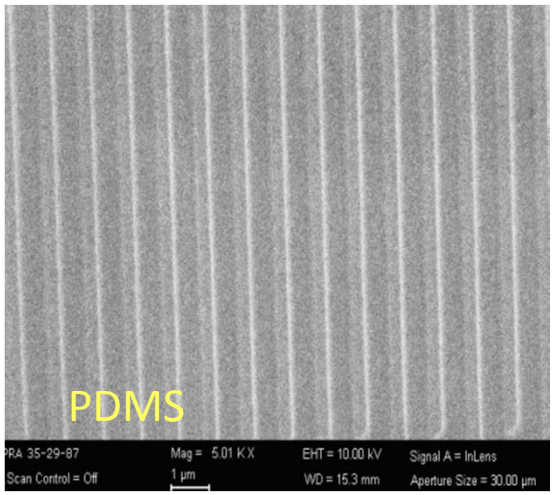
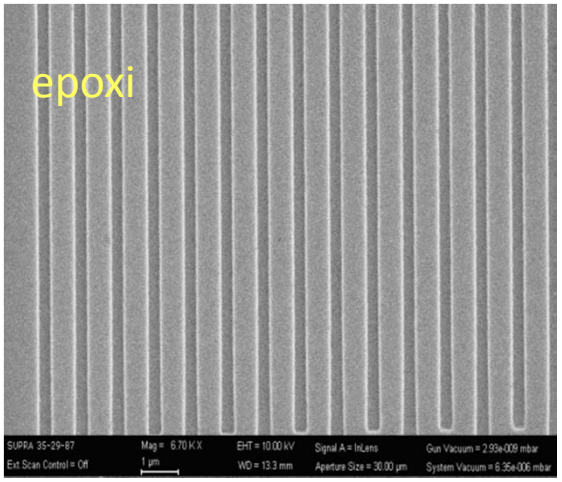
Micro-optica difractiva- Tehnologii

- **Replicare a unor mastere cu profil 2D/3D**

Retele de difractie- lina de 200 nm replicate in rasina epxidica







Original → Copie negativa → Copie pozitiva

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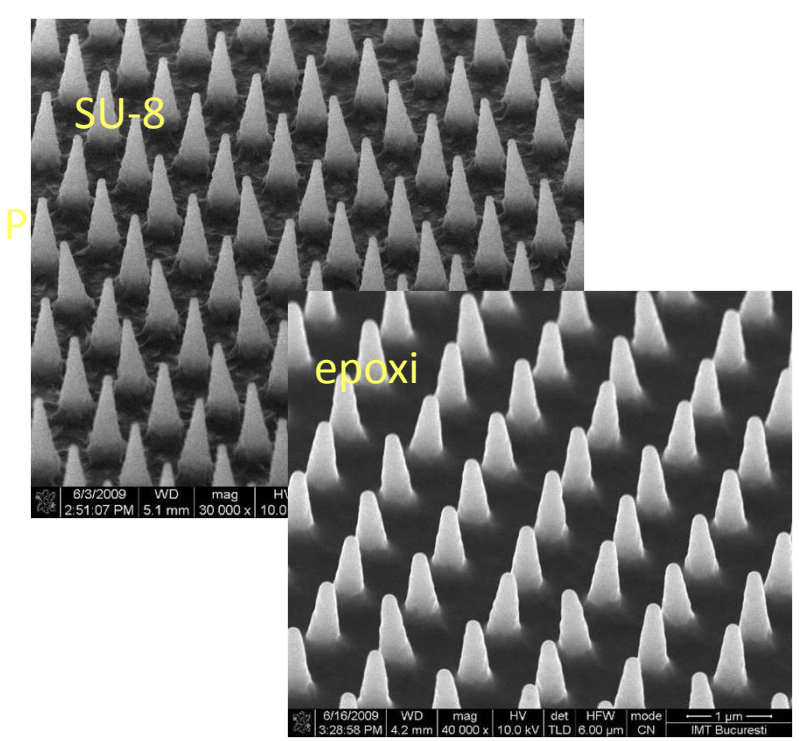
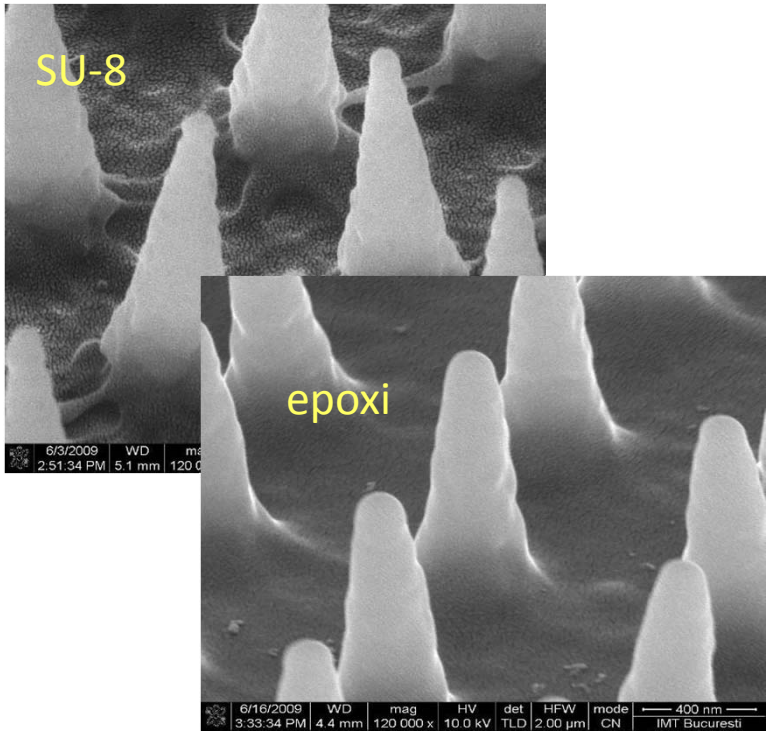
Micro-optica difractiva- Tehnologii

- **Replicare a unor mastere cu profil 2D/3D**





Replica in rasina epoxi resin a unor originale realizate in SU-8

(s-a utilizat o matrita de PDMS- copia negativa)

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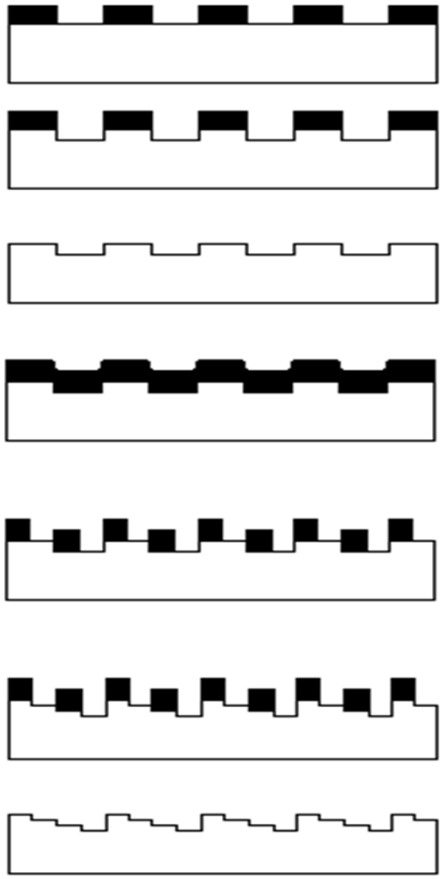
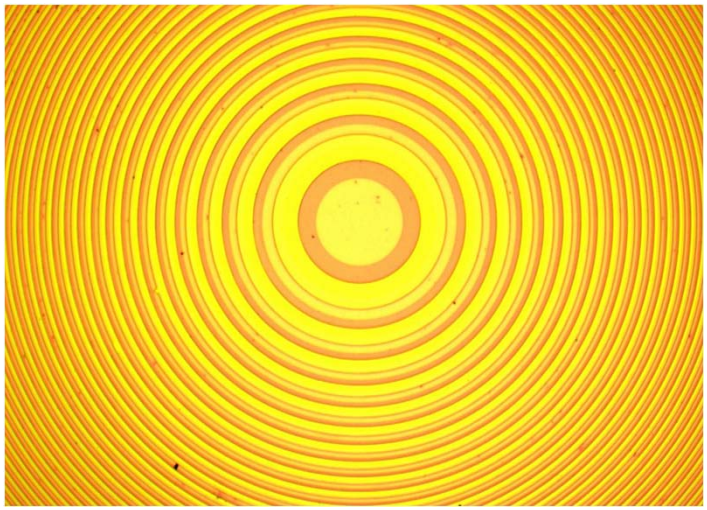
Micro-optica difractiva- Tehnologii

- **Structurii multinivel obtinute prin etape succesive de litografie si corodare**



Corodarea controlata cu precizie de ordinul nm

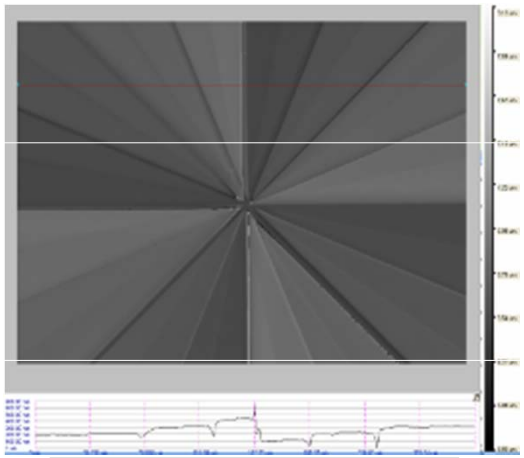


Lentila Fresnel cu 4 nivele

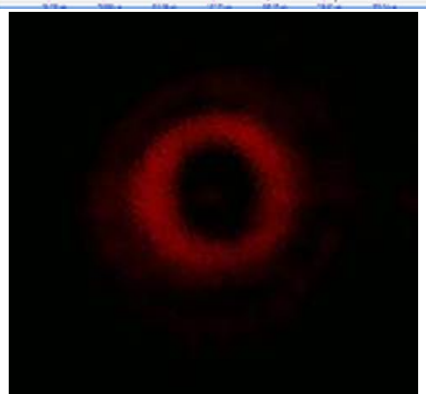
Micro-optica difractiva-Tehnologii

- **Structurii multinivel obtinute prin etape succesive de litografie si corodare**

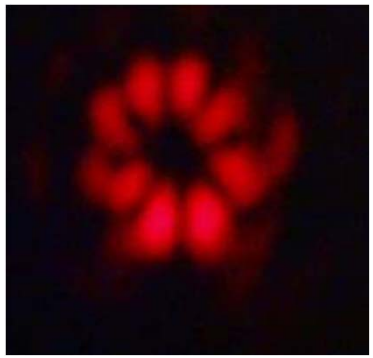
c)



Imaginea de interferometrie in lumina alba a unui element optic difractiv cu 8 nivele (3 masti) care genereaza un vortex optic cu ordinul m=4.



vortex optic de ordinul m=4.



interferenta a doua vortexuri cu m=4 si m=-4.

IMT Bucureşti

Comunicatii optice securizate de mare capacitate prin spatiul liber, bazate pe holograme generate pe computer ***–Proiect PN-II-PT-PCCA 2011-2015***

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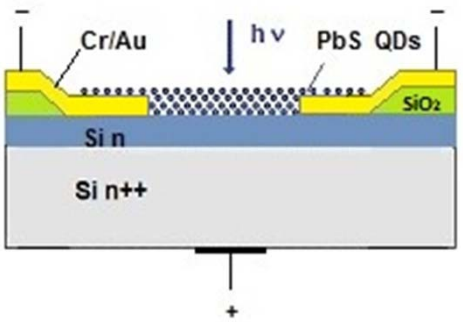
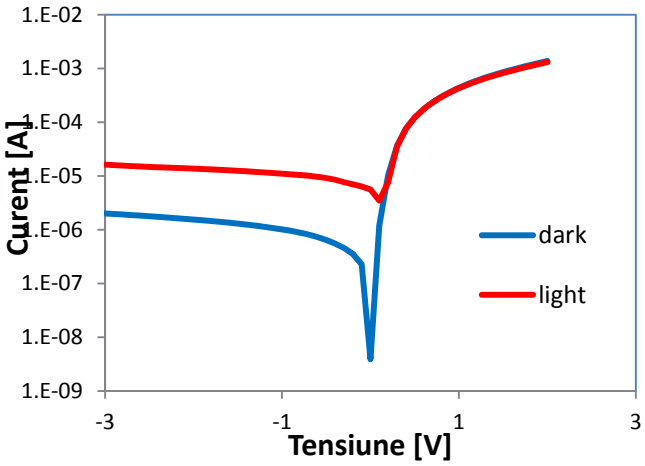
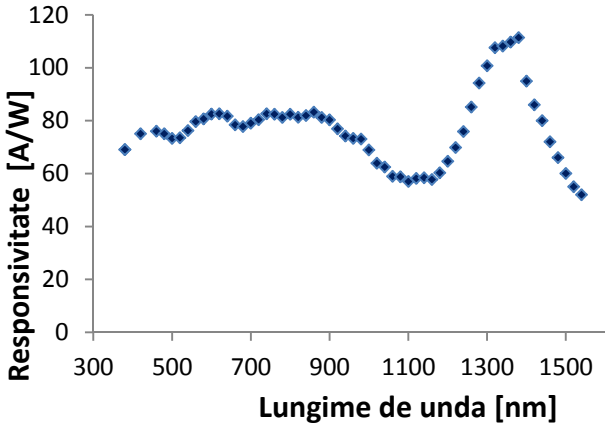
Fotodetectoare

Fotodetectoare cu raspuns imbunatatit in IR

Fotodetector hibrid PbS/Si-secțiune realizarte prin depunerea de straturi subtiri de puncte cuantice de PbS (PbS QDs) peste structuri Schottky Au/Si







Sectiune prin structura si modul de polarizare

Caracteristicile I-V la intuneric si iluminare;

Responsivitatea spectrala (V = 1V, Popt ~25 nW)

Responsivitati in domeniul 60-100 A/W pt. λ = 350…1550 nm

IMT București

Fotodetectoare pe straturi subtiri- noi concepte si studii privind utilizarea in aplicatii aerospatiale ***Proiect STAR***

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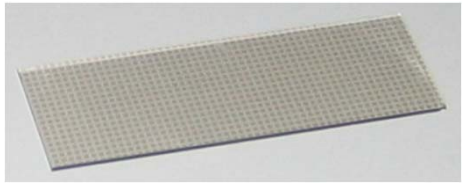
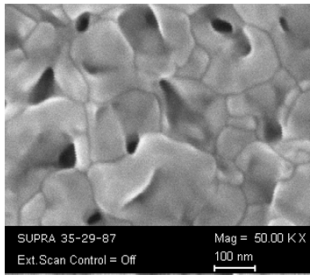
Fotodetectoare

Senzori pentru radiatia UV cu factor de rejectie mare a radiatiei vizibile pe baza de straturi subtiri oxidice nanostructurate

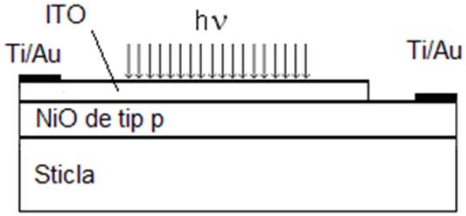
Structurile de detectie pentru radiatia UV cu heterojonctiune transparenta s-au realizat pe substrat transparente (sticla , cuart, substrat flexibil de PET) utilizand straturi subtiri de semiconductoare oxidice de banda larga (> 3eV) de tip n si p: p–NiO, n-ZnO, n-ITO, p-CuO.



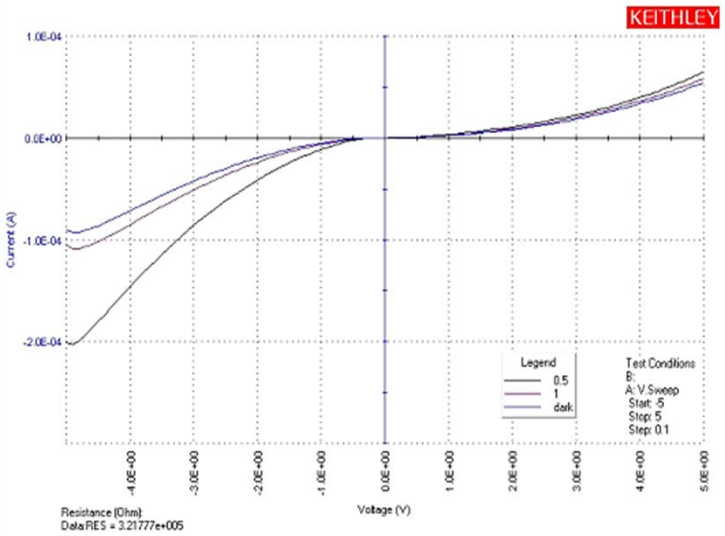
structura cu heterojonctiune transparenta NiO(p)/ITO(n)



imagine SEM a stratului de NiO nanostructurat



reprezentare schematica a sectiunii prin structura



$\lambda < 350$ nm - I ~300 μA

$\lambda > 400$ nm - I ~ I_{dark}

→ absorbtia radiatiei UV are loc in stratul de NiO si colectarea purtatorilor in jonctiunea transparenta

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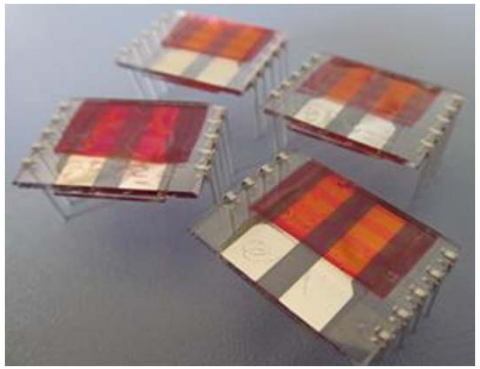
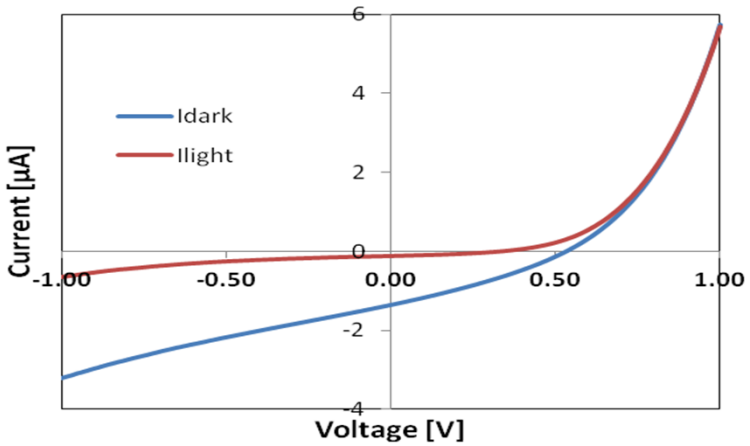
Fotodetectoare

Dispozitive pe baza de nanoparticule de ZnO

Au fost obtinute componente si dispozitive experimentale de tip heterojonctiuni de volum (BHJ) sensibile la iluminare atit in vizibil cat si in UV.
Structurile experimentale obtinute de tip: ITO/ZnO/P3HT:PC61BM/PEDOT:PSS/Ag si ITO/ZnO/P3HT:PC61BM/MoO_3/Ag



Imagini ale dispozitivelolor realizate



Caracteristicile I-V pentru un dispozitiv fotovoltaic de tip ITO/ZnO/P3HT:PC61BM/MoO_3/Ag cu strat de ZnO de 40 nm grosime si arie de 4,5 mm^2

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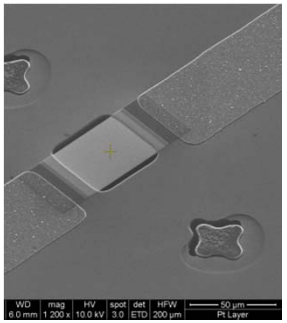
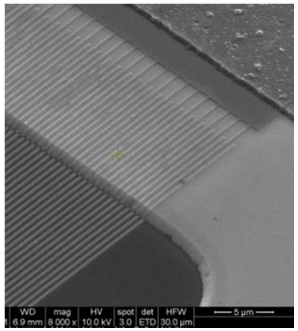
Fotodetectoare

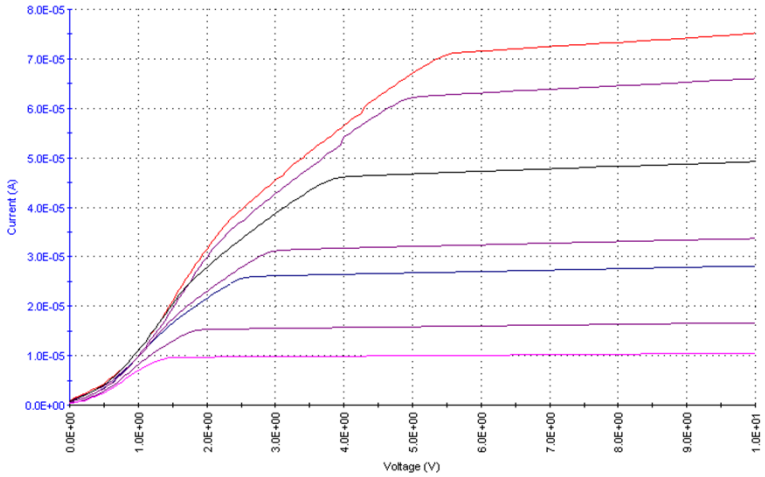
Fotodetectoare rapide si eficiente de tip MSM cu electrozi transparenti submicronice pe straturi subtiri de materiale semiconductor

fotodetectoare de tip MSM cu electrozi interdigitati si transparenti de 150 nm si 300 nm latime din straturi oxidice transparente si conductive de tip n - ITO, ZnO pe substrate ultrasubtiri de siliciu (~ 2µm plachete SOI).

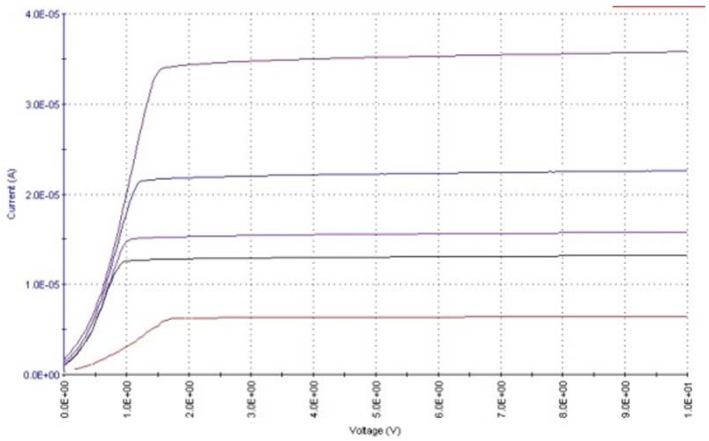




Caracteristicile I-V diverse nivele de iluminare in UV (365 nm)



MSM cu electrozi de 150 nm latime



MSM cu electrozi de 300 nm latime

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