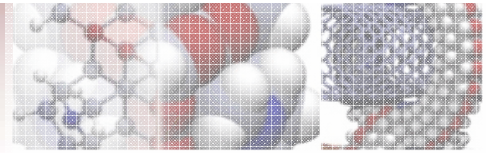

Nanotexturarea periodica a suprafetelor metalice cu pulsuri laser ultrascurte

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1) *INFLPR – Bucuresti, Atomistilor 409, 077125 Magurele, Romania.*
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Sumarul prezentarii

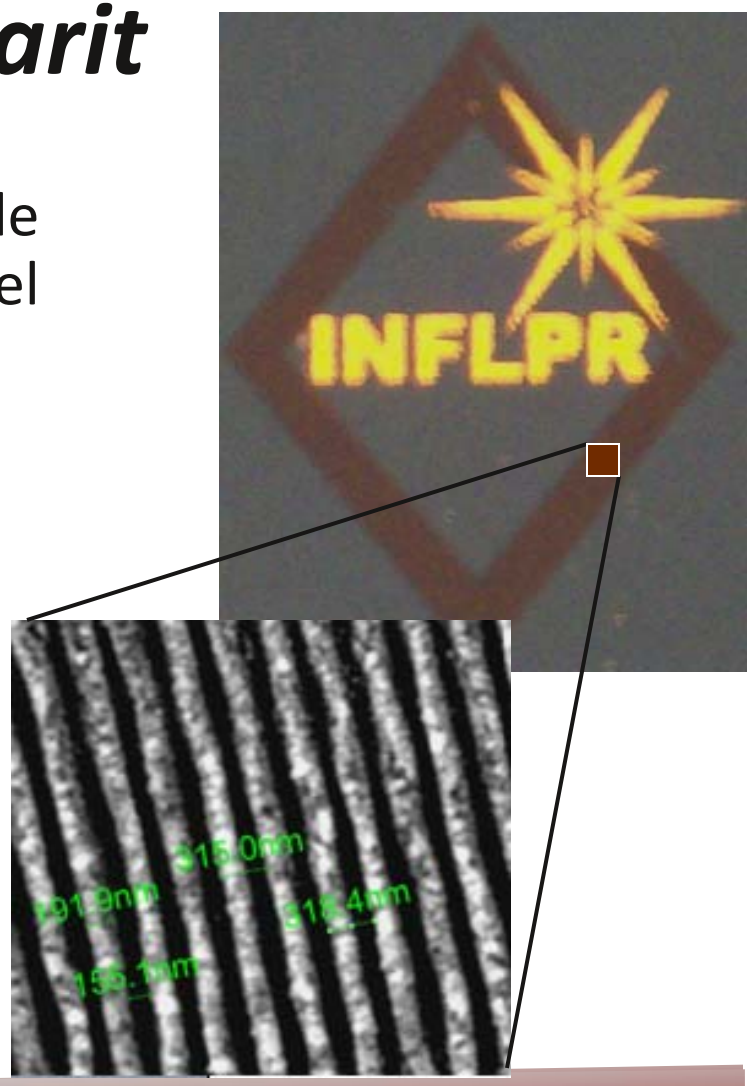
- *Scopul principal urmarit*
- *Procesarea laser a filmelor subtiri metalice: Ti, Ni, Cr, Pt*
- *Experimente de procesare in diferite conditii de expunere laser*
- *Concluzii*

Scopul principal urmarit

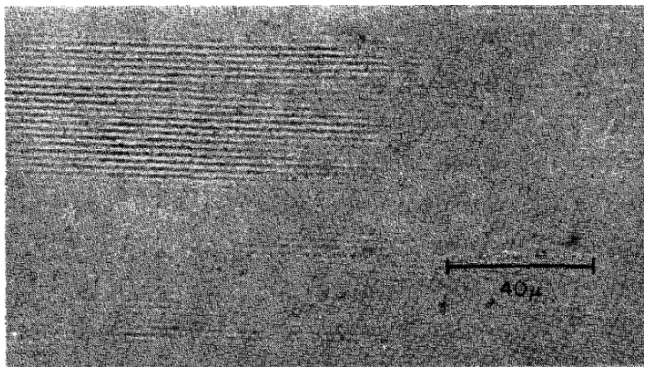
- Dezvoltarea unor metode optice de procesare a materialelor la nivel nanometric pe suprafete extinse.

Aplicatii:

- Marcaje de securitate.
- Modificarea proprietatilor tribologice ale suprafetei materialelor.
- Marirea suprafetei efective pentru cresterea sensitivitatii micro-senzorilor.



1965 - Primele evidente ale formarii structurilor periodice



Semiconductor Surface Damage Produced by Ruby Lasers*

MILTON BIRNBAUM
Aerospace Corporation, El Segundo, California
(Received 21 January 1965; in final form 24 June 1965)

Teorii existente asupra formarii structurilor periodice

a) Teoria interferentiala (ablatie laser) – Sipe et al. 1983
b) Teoria autorganizarii (topire si recristalizare) – J. Reif et al. 2002
c) Teoria plasmei de electroni (ablatie laser) – Y. Shimotsuma et al. 2003
d) Teoria plasmonilor de suprafata (ablatie laser) – J. Miyaji et al. 2008

Procesarea laser a suprafetelor

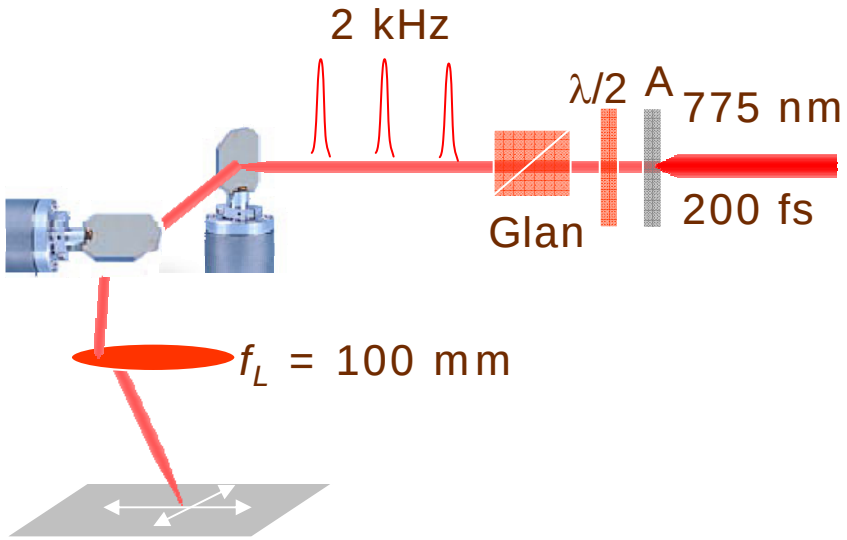
Conditiile de procesare laser:

- *Laser cu pulsuri ultrascurte: 200 fs, lungime de unda 775 nm, frecventa de repetitie 2 kHz.*
- *Dimesiune spot laser 35 μm.*
- *Fluente laser sub pragul de ablatie.*
- *Scanarea suprafetei:*

  a) translatarea probei (XY).

  b) scanare cu oglinzi galvanometrice

  - permite procesare pe arii mari in timp scurt (mm/s).

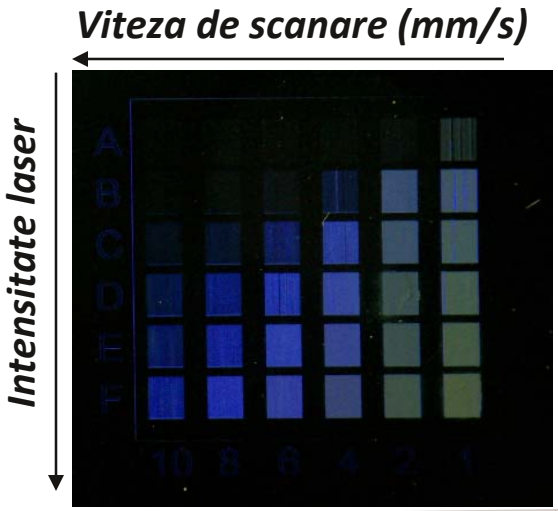


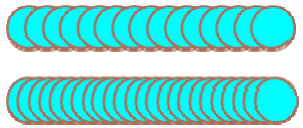
Metoda de "scriere" directa

Experimente de procesare in diferite conditii de expunere laser

Morfologia structurilor depinde de:

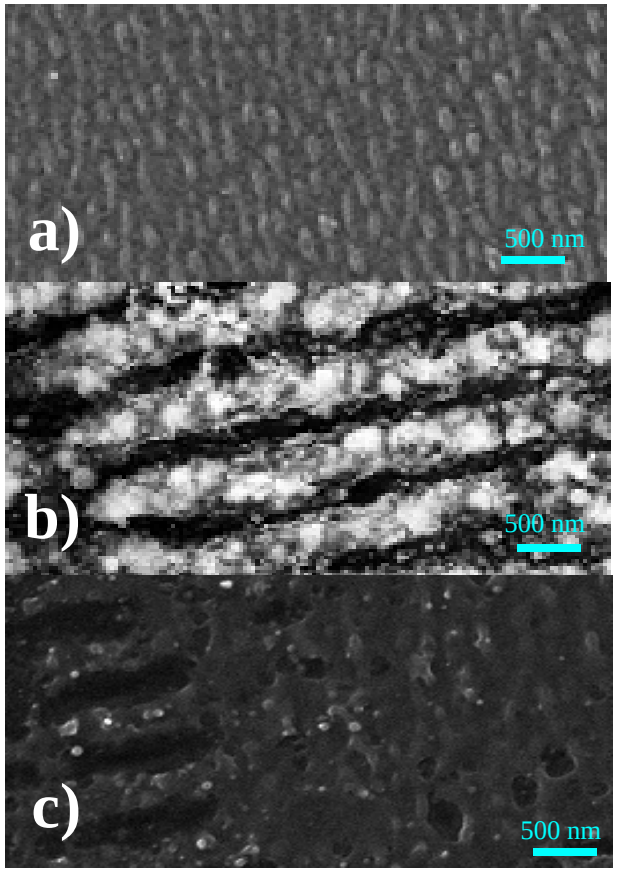
- *fluenta laser : 0.09 - 0.3 J/cm²*
- *numar pulsuri (viteza de scanare) : 1-10 mm/s*
- *polarizare*
- *natura materialului*



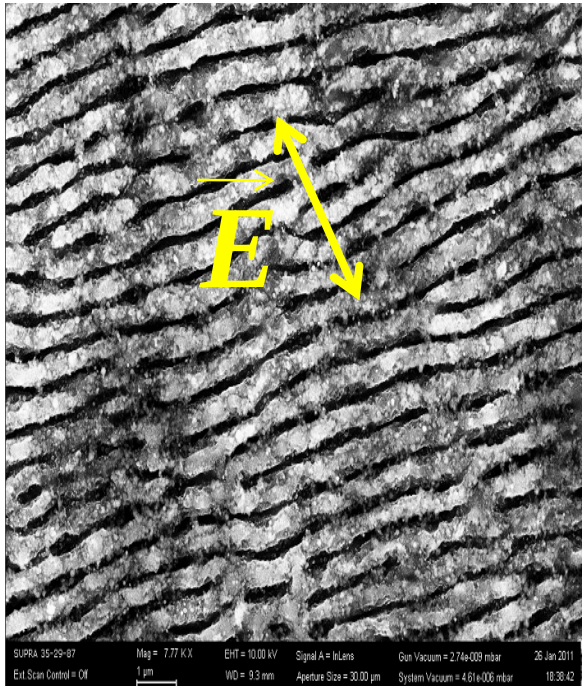


Film Ni 150 nm / Si (111)

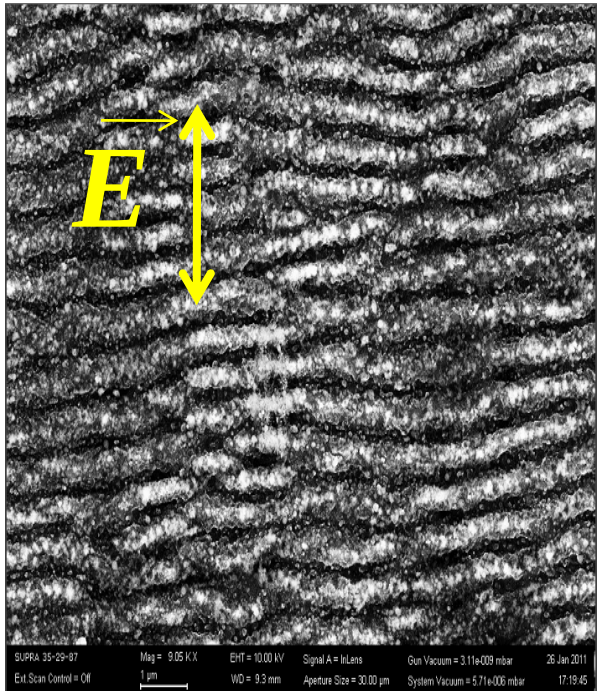
a) A1: 1 mm/s, 0.18 J/cm²
b) D2 : 2 mm/s, 0.23 J/cm²
c) F1 : 1 mm/s, 0.25 J/cm²



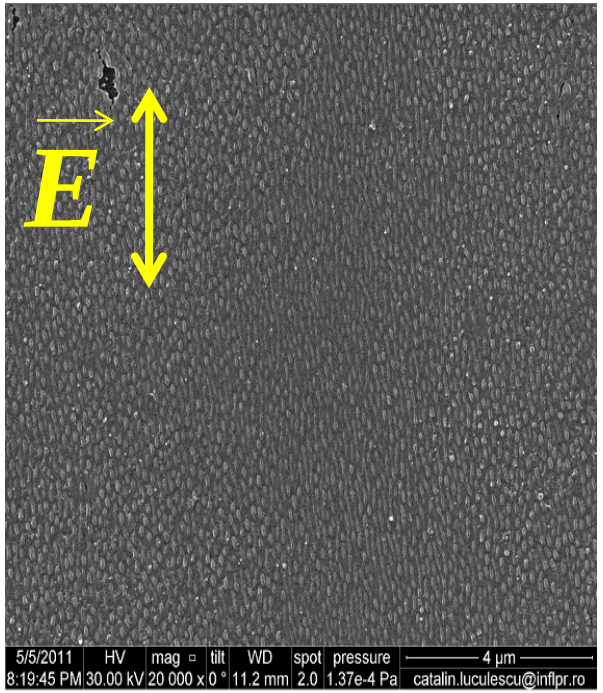
Dependenta orientarii structurilor periodice de directia de polarizare a laserului



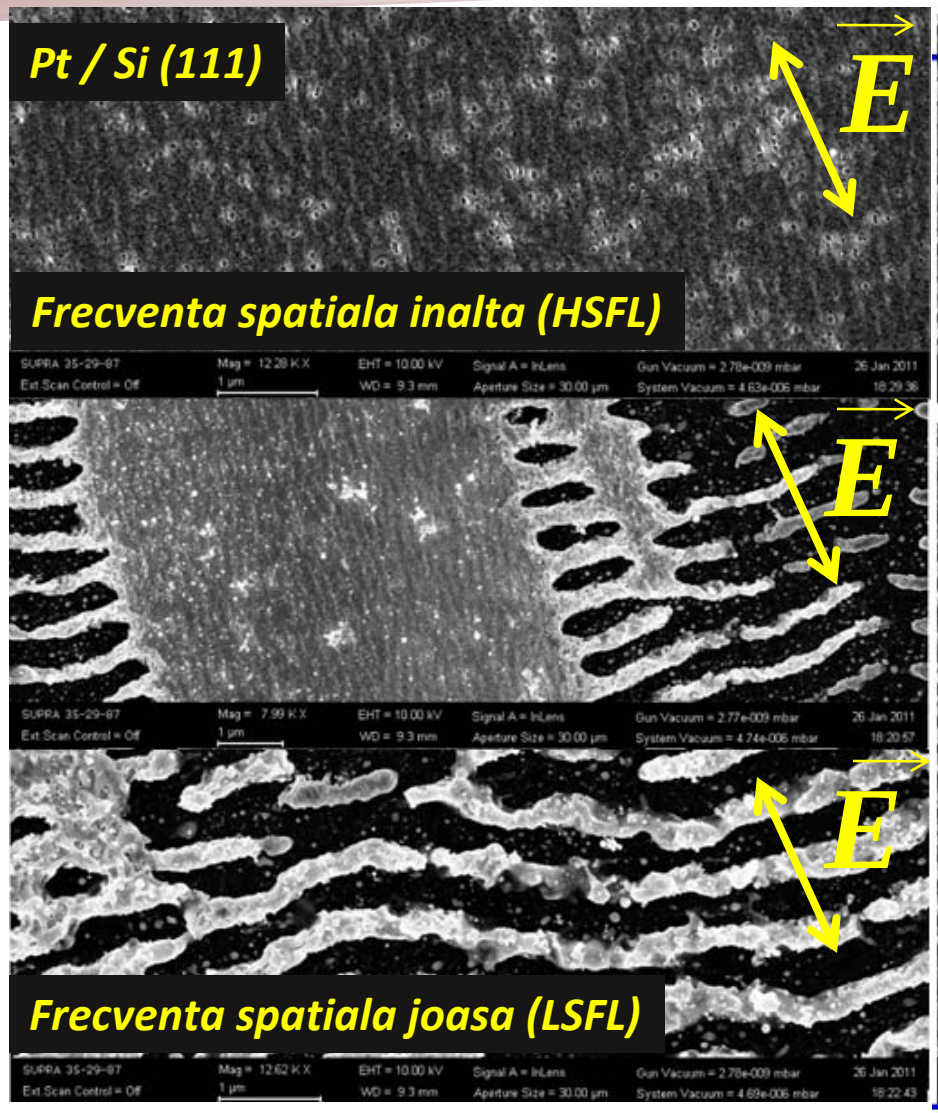
Ni

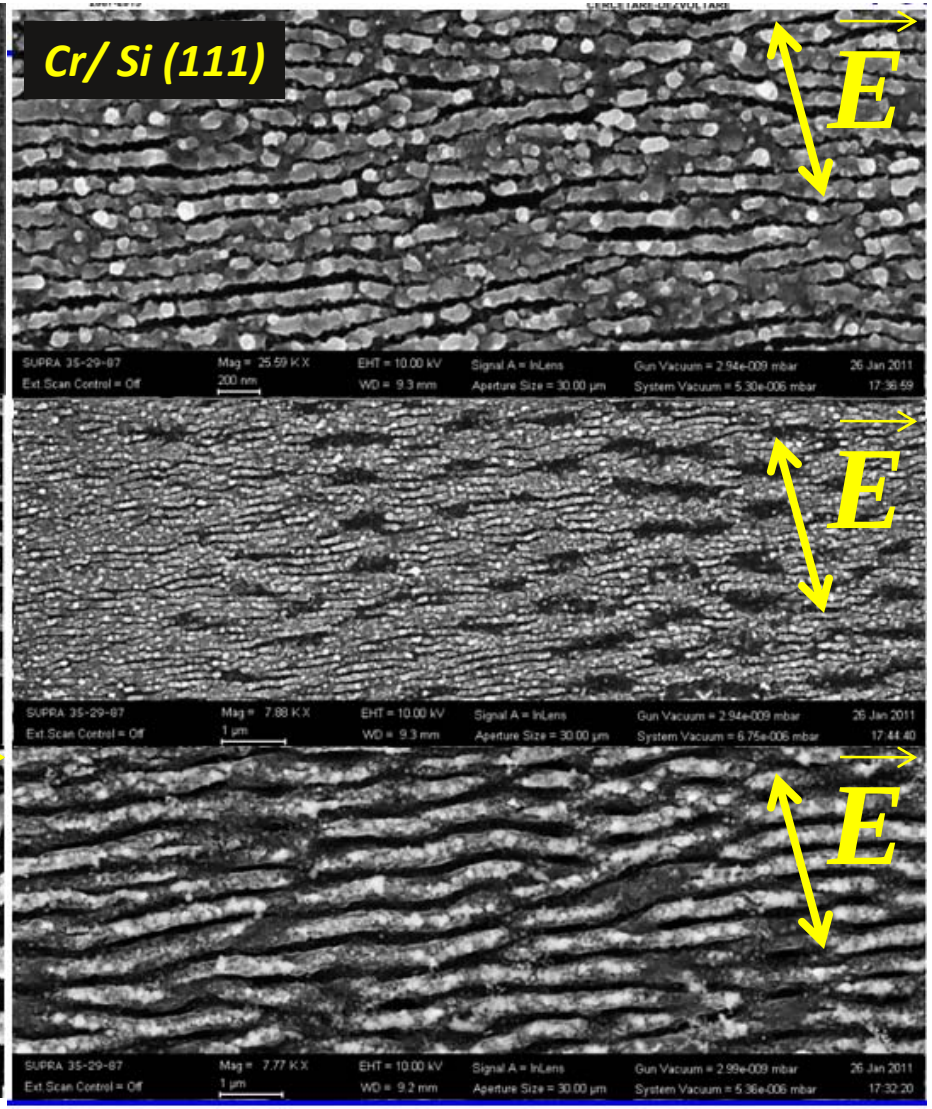


Ti

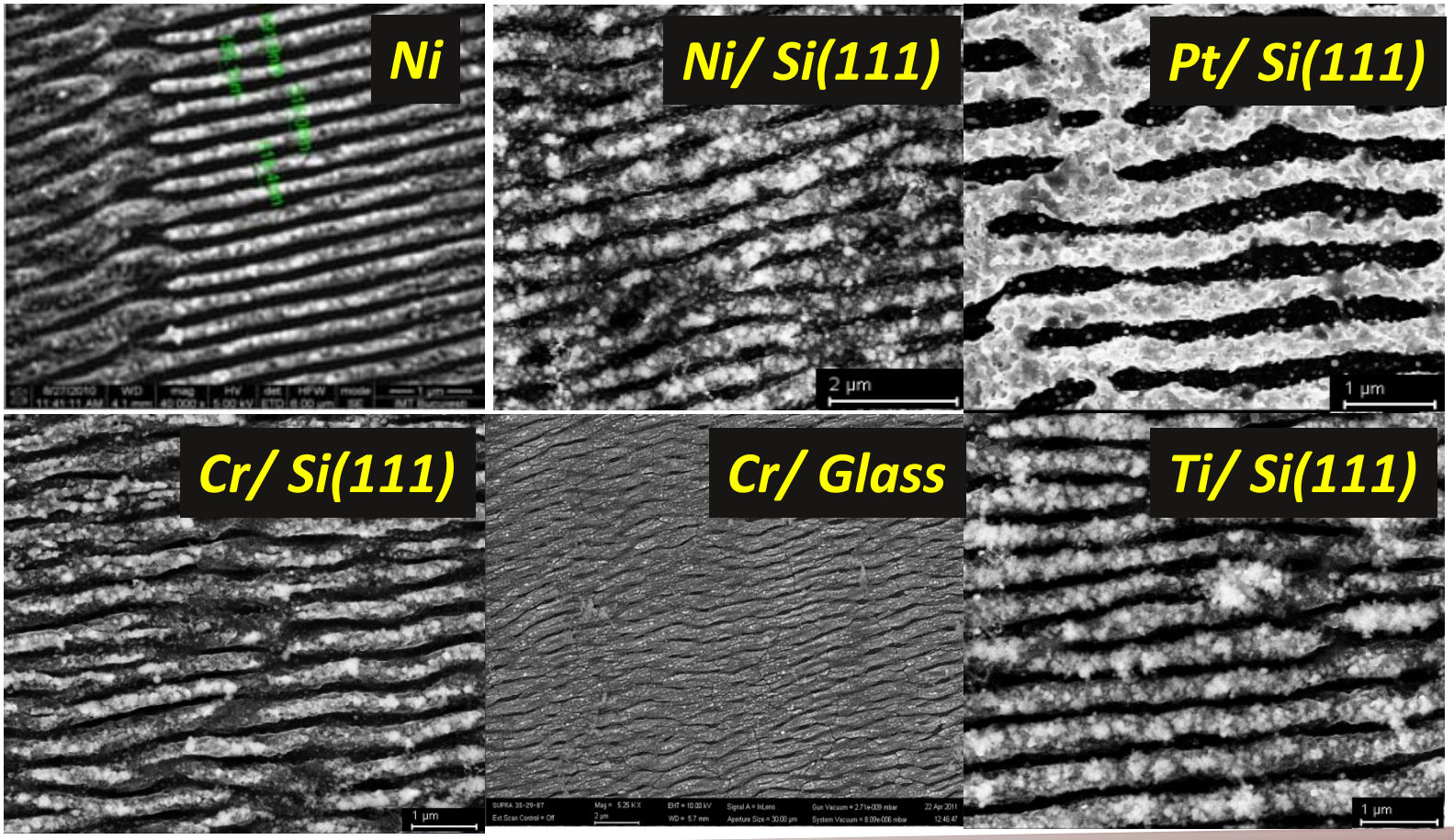


Ni

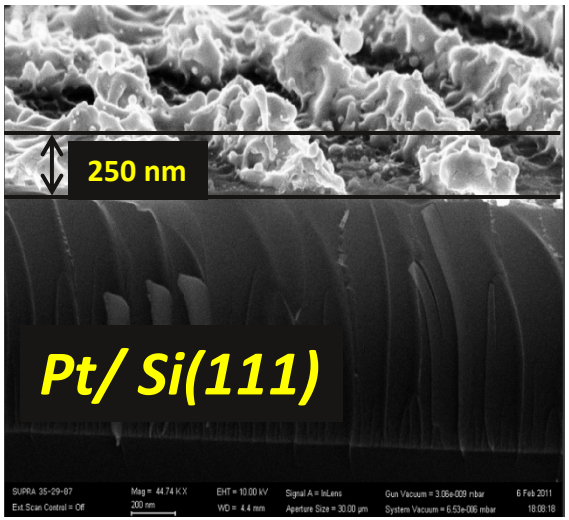

Pt / Si (111)
E
Frecventa spatiala inalta (HSFL)
E
Frecventa spatiala joasa (LSFL)
E

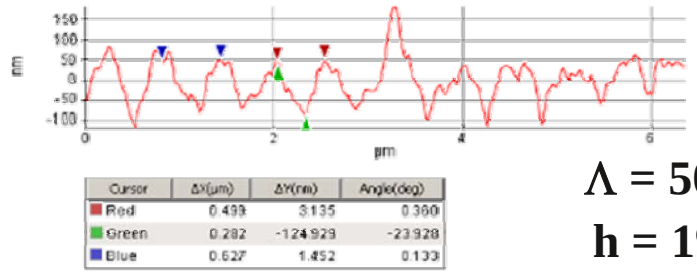

Cr/ Si (111)
E
E
E

Dependenta morfologiei structurilor periodice de natura materialului



Caracterizare SEM si AFM

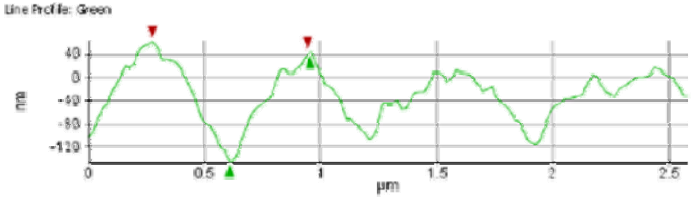




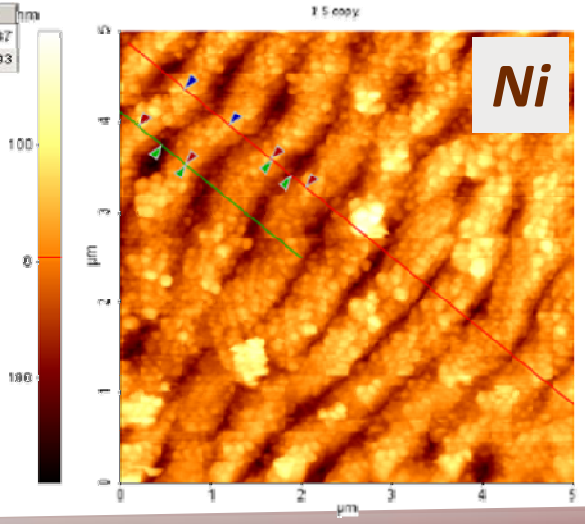
Cursor	ΔX(µm)	ΔY(nm)	Angle(deg)
Red	0.499	3.135	0.360
Green	0.282	-124.929	-23.928
Blue	0.627	1.452	0.133

Λ = 500-600 nm

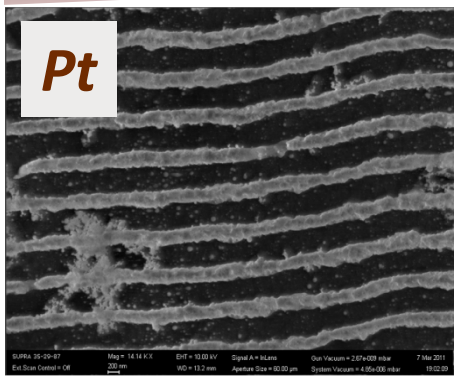
h = 190 nm

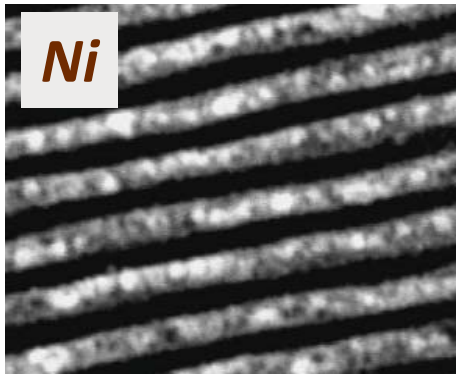


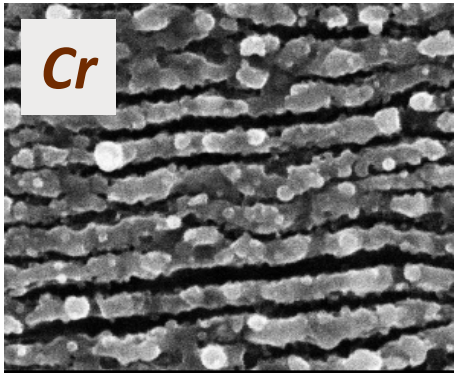
Cursor	ΔX(µm)	ΔY(nm)	Angle(deg)
Red	0.671	-20.331	-1.737
Green	0.348	189.114	28.503



Dependenta perioadei structurilor de natura materialului

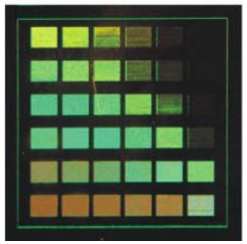






Material	Perioada structurilor Λ	Indice de refractie @ λ = **775** nm	λ_0/n
Ni	HSFL: 160-190 nm ∥ HSFL: 300-330 nm ⊥ LSFL: 600-660 nm ⊥	2,43-i*4,31	318 nm
Ti	HSFL: 90-120 nm ∥ LSFL: 460-530 nm ⊥	2,74-i*3,3	282 nm
Pt	HSFL: 190-220 nm ∥ LSFL: 550- 600 nm ⊥	2,76-i*4,84	280 nm
Cr	HSFL : 120-140 nm ⊥ LSFL: 630-690 nm ⊥	3,11-i*3,44	249 nm

Concluzii



- S-au obtinut suprafete nano-structurate cu laserul femtosecunde pe suprafete metalice pe arie extinsa (mm^2).
- Perioada structurilor auto-organizate depinde de natura materialului si conditiile de iradiere (100-700 nm).
- Orientarea structurilor periodice depinde de directia de polarizare a radiatiei laser. Nu depinde de directia de scanare.

Va multumesc pentru atentie!

M.Zamfirescu multumeste Proiectului POSDRU/89/1.5/S/63700 pentru suportul financiar.

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