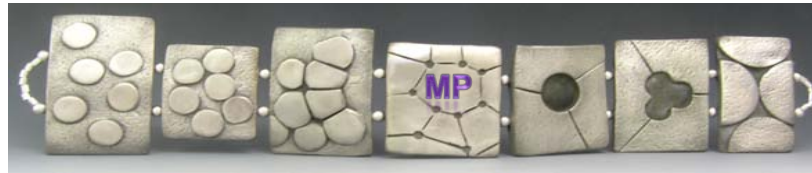




Aplicatii actuale si viitoare ale materialelor nanostructurate obtinute prin tehnologia metalurgiei pulberilor

Oana GINGU, Cristina TEISANU, Gabriela SIMA,
Daniela COMAN, Mihail MANGRA

Universitatea din Craiova, Facultatea de Mecanica



CUPRINS

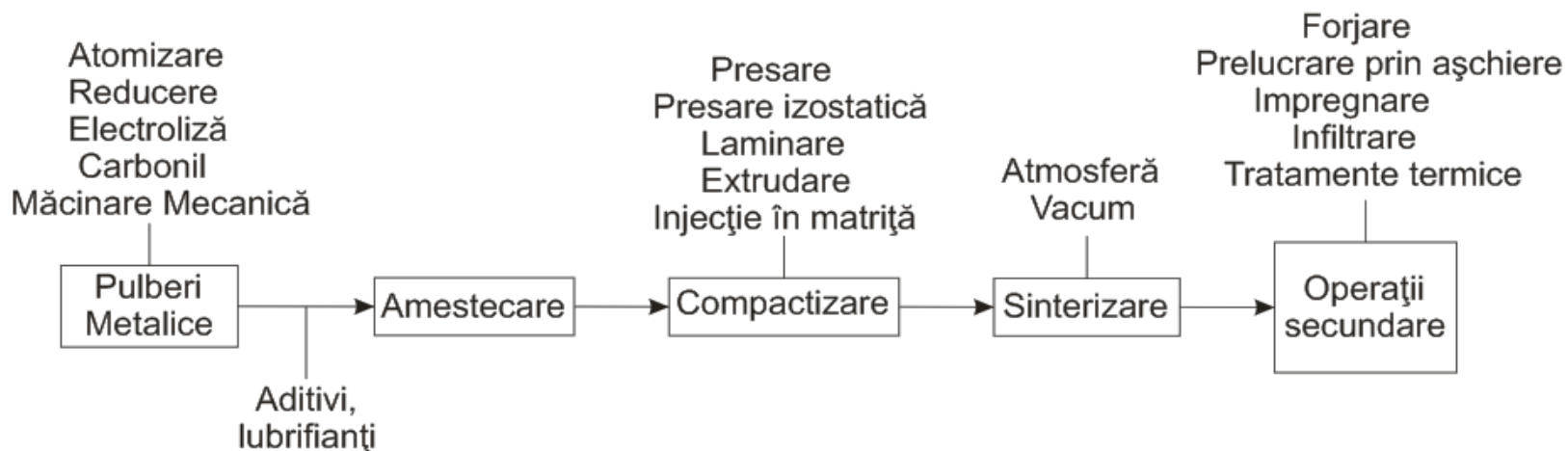
1. Tehnologia METALURGIEI PULBERILOR (MP)
2. Elaborare si caracterizare de NANOPARTICULE de pulberi
3. Elaborare si caracterizare de MATERIALE SINTERIZATE NANOSTRUCTURATE
4. Modelare si simulare a comportamentului mecanic al MATERIALELOR SINTERIZATE NANOSTRUCTURATE
5. Directii viitoare

Mulumiri adresate colaboratorilor si partenerilor de cercetare



1.

METALURGIA PULBERILOR



AVANTAJE

- Elaborare de materiale noi simultan cu produsul finit
- Obținere de produse finite cu precizie dimensională ridicată
- Obținere de produse finite de dimensiuni mici și geometrie complexă
- Pierderi minimale de material
- Eficiență tehnico-economică

DOMENII DE APLICATIE

- Inginerie: prelucrări mecanice, autovehicule rutiere și agricole, nave maritime și fluviale, aerospațială, protecția mediului, alimentară etc.
- Bioinginerie: instrumentar medical, implanturi etc.

- Ingineria opto-electronică
- Ingineria tesuturilor

MATERIALE RECOMANDATE

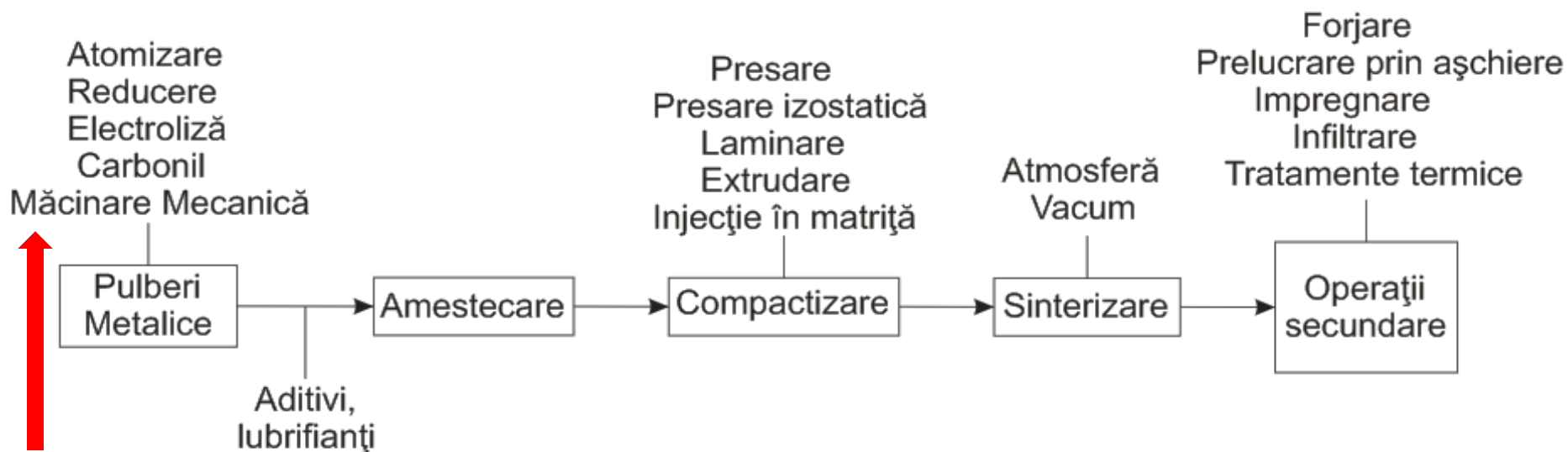
- Materiale metalice / ceramice / compozite dificil de elaborat prin tehnologii convenționale
- Materiale izotrope/anizotrope/cu gradient funcțional
- Materiale "bulk" sau filme subțiri de acoperire
- Microstructurate și nanostructurate
- Structuri compacte/tip spuma

- nanoaliaje Ag-Cu
- biocompozite HAP/Ti



2. Elaborare si caracterizare de NANOPARTICULE de pulberi

□ Ingineria opto-electronica: nanoaliaje Ag-Cu



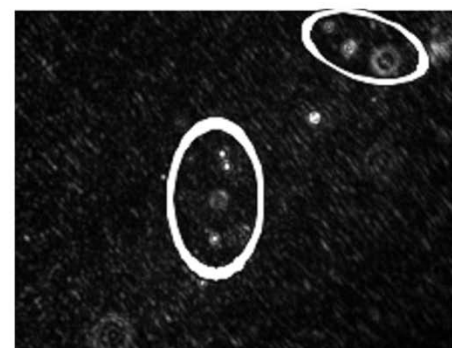


2. Elaborare si caracterizare de NANOPARTICULE de pulberi

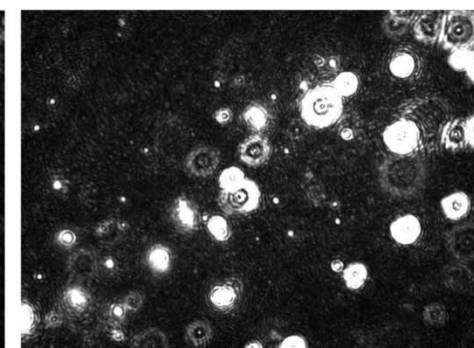
□ Ingineria opto-electronica: nanoaliaje Ag-Cu elaborate prin Aliere Mecanica (AM)



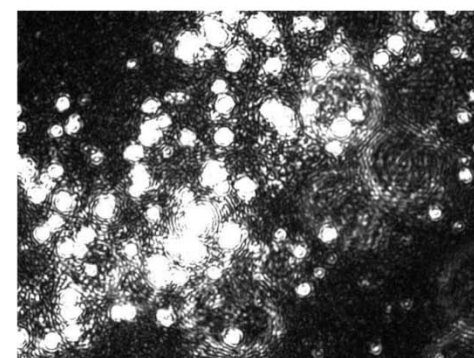
Moara planetara
Fritsch - Pulverisette 6



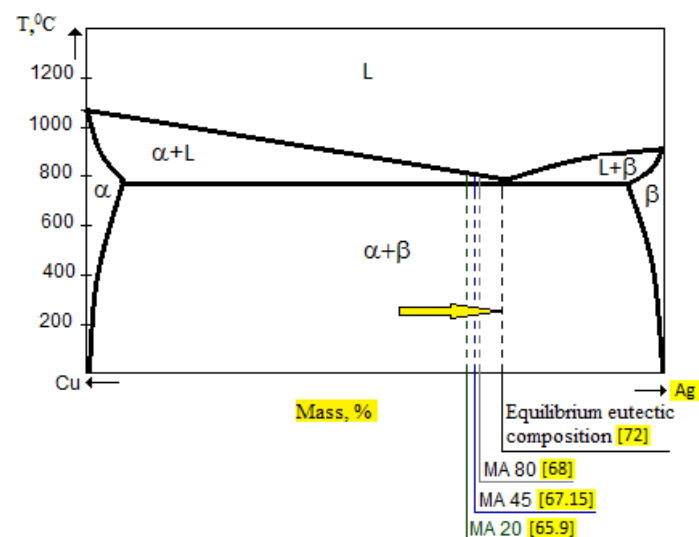
a)



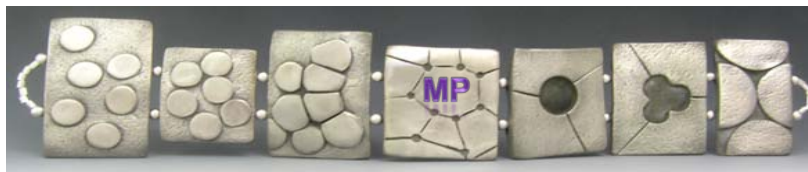
b)



c)

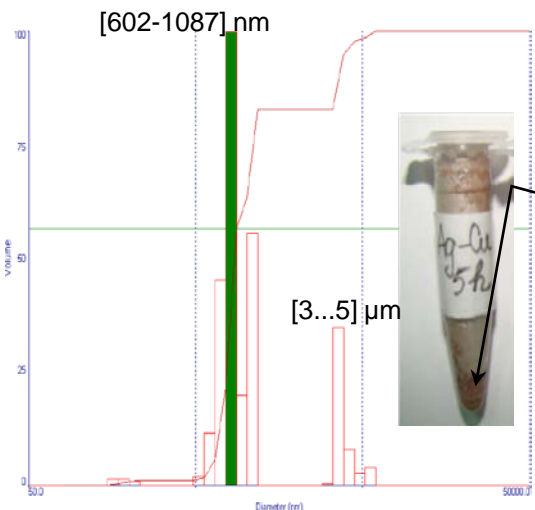


O. Gingu, P. Rotaru, A. Milea, A. Marin, C. Nicolicescu, G. Sima, S. Tanasescu, *Thermochimica Acta* 606, 1–11, 2015

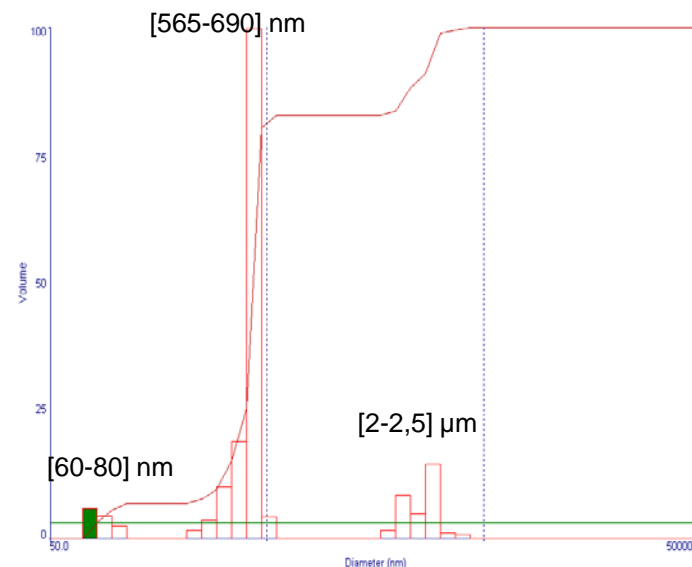


2. Elaborare si caracterizare de NANOPARTICULE de pulberi

□ Ingineria opto-electronica: nanoaliaje Ag-Cu elaborate prin Aliere Mecanica (AM)

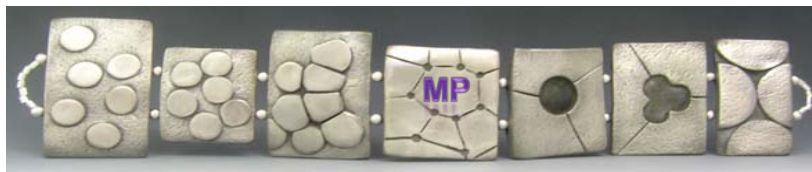


Distributia granulometrica pt amestecul 72Ag+28Cu
(% mass.) dupa **5h AM**



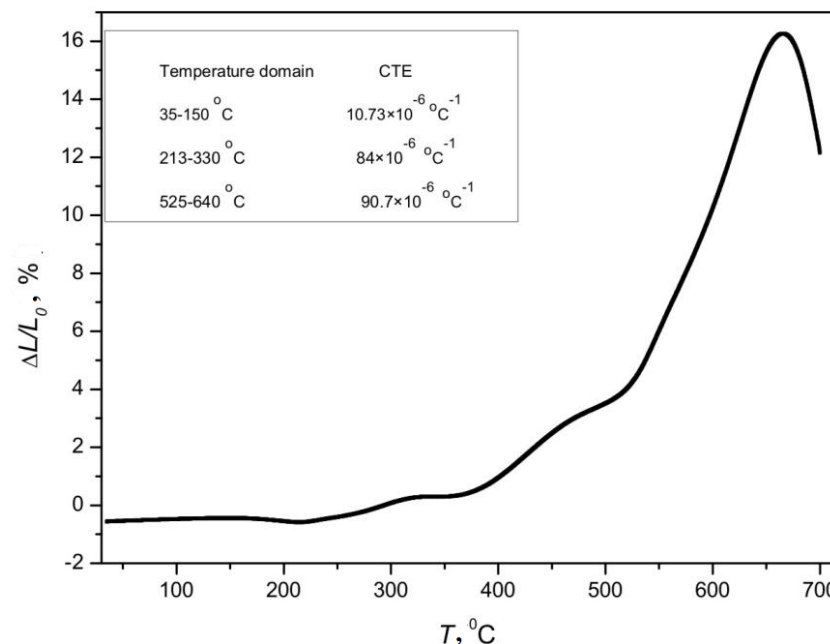
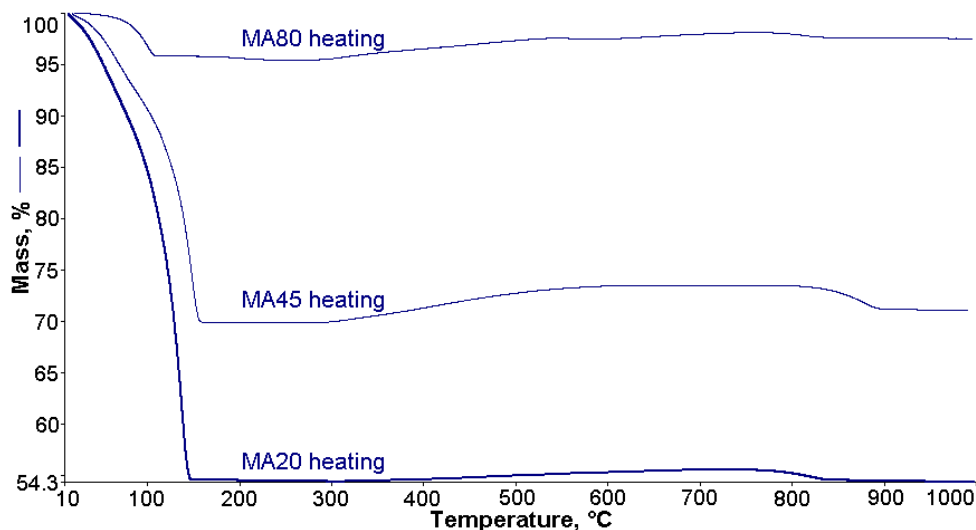
Distributia granulometrica pt amestecul 72Ag+28Cu
(% mass.) dupa **80h AM**

Gingu O, Nicolicescu C, Sima G, Solid State Phenomena, vol.188, 382-387, 2012



2. Elaborare si caracterizare de NANOPARTICULE de pulberi

□ Ingineria opto-electronica: nanoaliaje Ag-Cu elaborate prin Aliere Mecanica (AM)

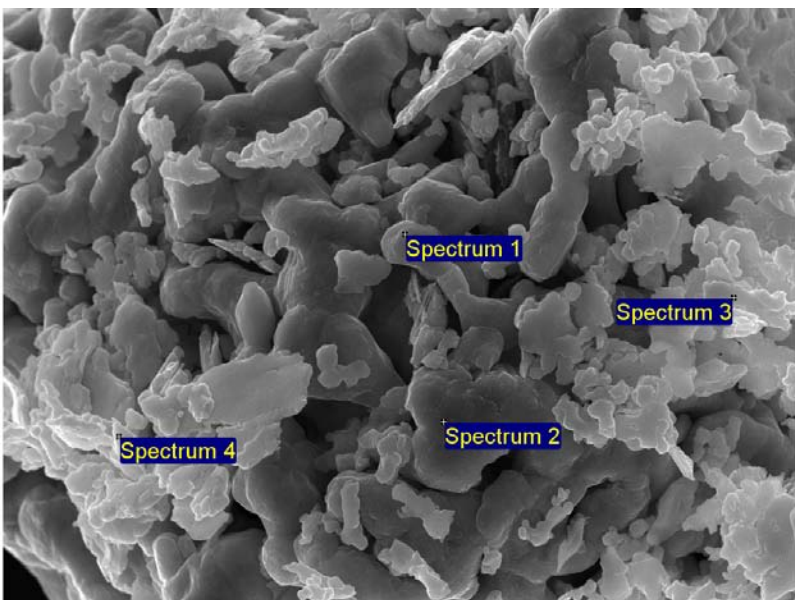


O. Gingu, P. Rotaru, A. Milea, A. Marin, C. Nicolicescu, G. Sima, S. Tanasescu, *Thermochimica Acta* 606, 1–11, 2015

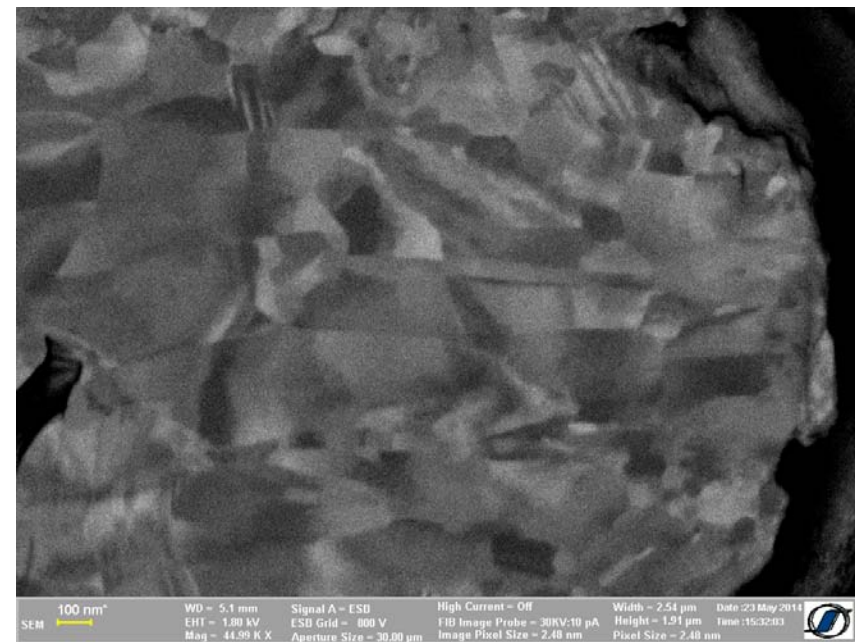


2. Elaborare si caracterizare de NANOPARTICULE de pulberi

□ Ingineria opto-electronica: nanoaliaje Ag-Cu elaborate prin Aliere Mecanica (AM)



Imagini FIB pentru probele MA80



Spectrum	Spectrum 1	Spectrum 2	Spectrum 3	Spectrum 4	Mean	Std.deviation	Max.	Min.
Cu [wt%]	90.60	97.25	4.71	11.31	50.97	49.75	97.25	4.71
Ag [wt%]	9.40	2.75	95.29	88.69	49.03	49.75	95.29	2.75
Total[wt%]	100.00	100.00	100.00	100.00	100.00			

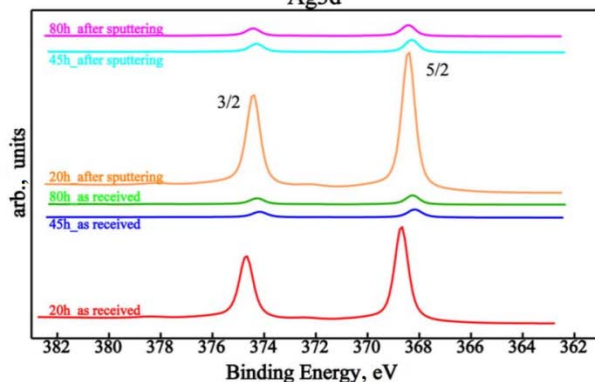
Courtesy by Dr. Nicoleta LUPU, National Institute of Technical Physics, Iasi, Romania



2. Elaborare si caracterizare de NANOPARTICULE de pulberi

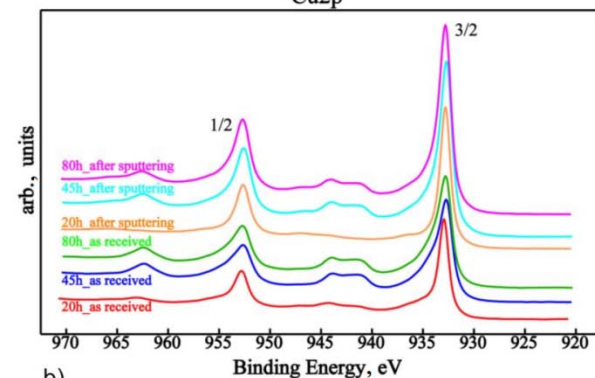
□ Ingineria opto-electronica: nanoaliaje Ag-Cu elaborate prin Aliere Mecanica (AM)

Ag3d



a)

Cu2p

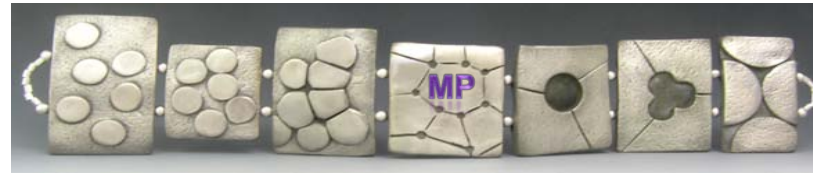


b)

Sample	C1s	O1s	Cu2p	Ag3d
MA20	8.1	15.0	37.3	39.6
As received	-	16.3	40.6	43.1
	-	-	48.5	51.5
MA45	6.4	19.8	69.3	4.5
As received	-	21.2	74.0	4.8
	-	-	93.9	6.1
MA80	8.6	19.7	66.8	4.9
As received	-	21.6	73.1	5.3
	-	-	93.2	6.8
MA20	4.2	10.7	37.1	48.0
After Ar Ion Sputtering	-	11.2	38.7	50.1
	-	-	43.6	56.4
MA45	2.9	16.7	75.5	4.9
After Ar Ion Sputtering	-	17.2	77.8	5.0
	-	-	94.0	6.0
MA80	2.7	14.9	77.8	4.6
After Ar Ion Sputtering	-	15.2	80.0	4.8
	-	-	94.3	5.7

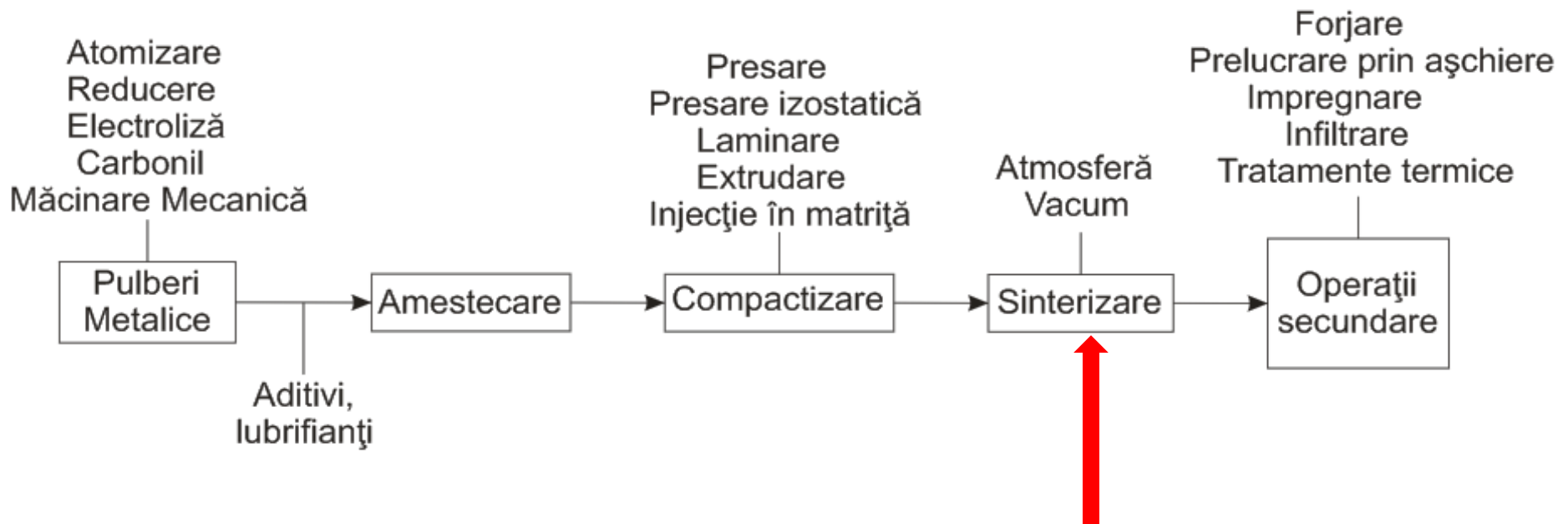
Spectre XPS ale probelor MA20, MA45 si MA80 pentru: (a) Ag 3d. (b) Cu 2p

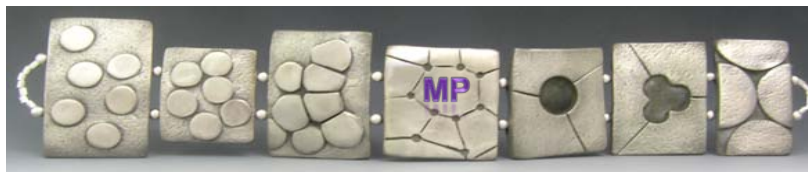
O. Gingu, P. Rotaru, A. Milea, A. Marin, C. Nicolicescu, G. Sima, S. Tanasescu, *Thermochimica Acta* 606, 1–11, 2015



3. Elaborare si caracterizare de MATERIALE SINTERIZATE NANOSTRUCTURATE

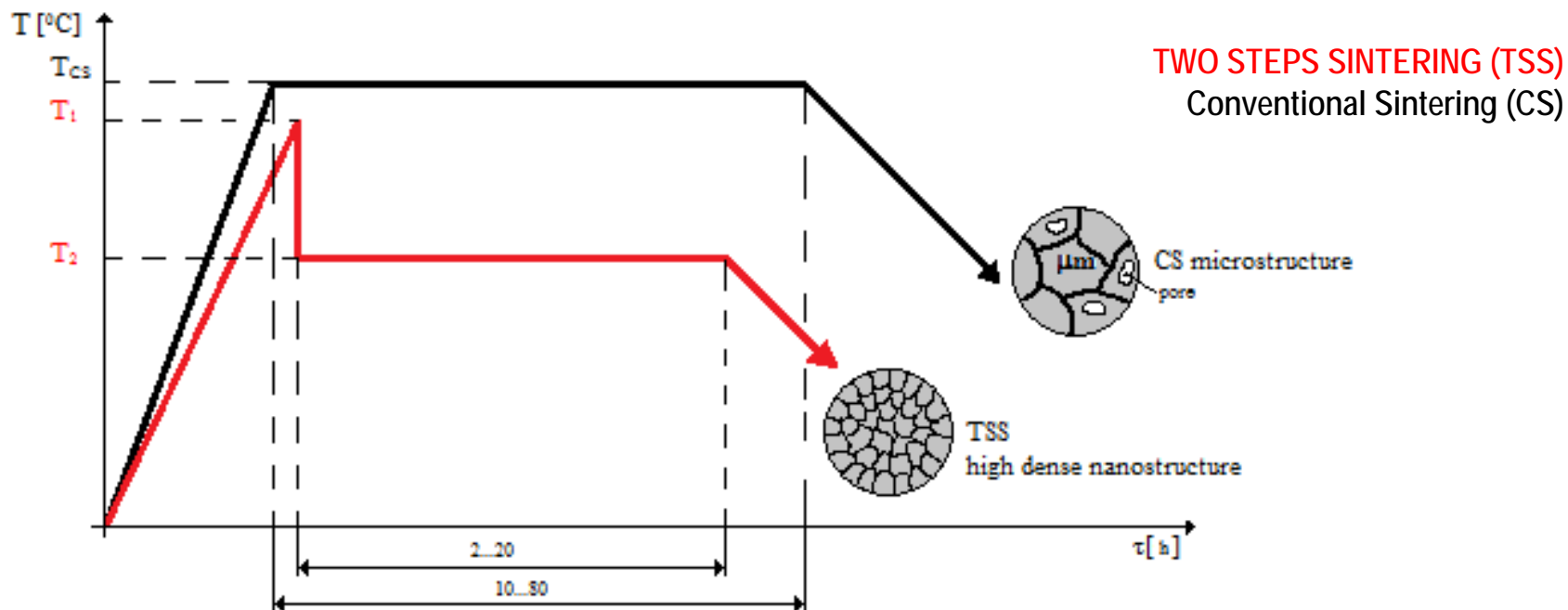
□ Ingineria tesuturilor: biocompozite HAP/Ti





3. Elaborare si caracterizare de MATERIALE SINTERIZATE NANOSTRUCTURATE

□ Ingineria tesuturilor: biocompozite HAP/Ti



Ruys A.J., Gingu, O., Sima, G., Maleksaeedi, S.

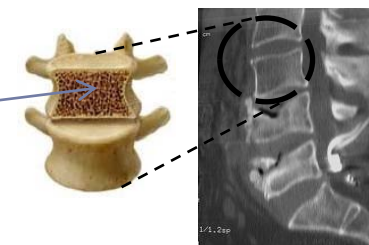
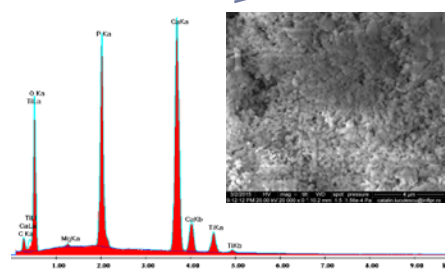
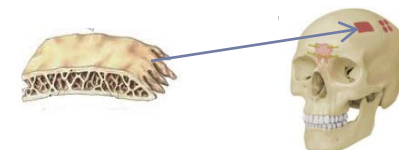
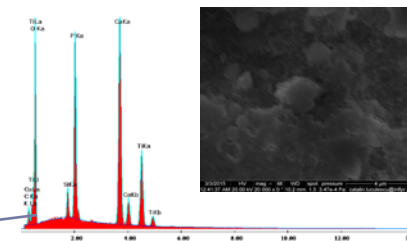
Handbook of Manufacturing Engineering and Technology, Chapter 7: Powder processing of bulk components in manufacturing, pp 1-69; Springer-Verlag London, 2014, DOI: 10.1007/978-1-4471-4976-7_48-4; Online ISBN 978-1-4471-4976-7, <http://www.springerreference.com/docs/html/chapterdbid/331461.html>



3. Elaborare si caracterizare de MATERIALE SINTERIZATE NANOSTRUCTURATE

□ Ingineria tesuturilor dure: biocompozite HAP/Ti obtinute prin TSS

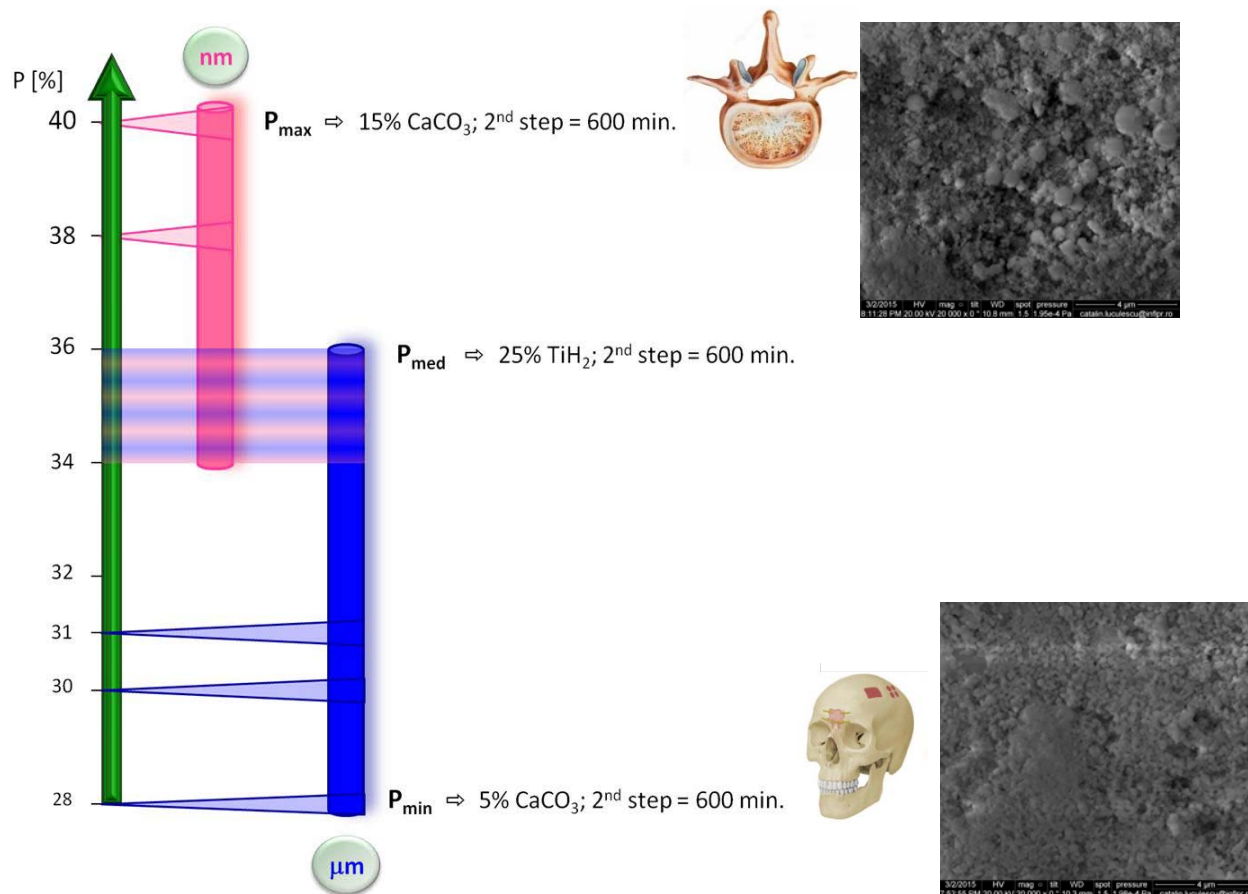
Sample code		Chemical composition [% wt]							
		green parts			TSS parts				
		HAP	TiH ₂	CaCO ₃	C	O	P	Ca	Ti
1	n I	75	25	-	4.29	40.74	12.25	26.72	16
	n II	75	25	-	6.07	40.50	11.27	27.63	14.44
2	μ I	75	20	5	4.73	36.76	17.47	35.84	4.99
	n I	75	20	5	5.27	35.85	14.37	35.25	9.09
3	μ I	75	10	15	4.74	37.14	16.44	36.37	5.07
	μ II	75	10	15	4.27	36.45	16.85	37.29	4.94





3. Elaborare si caracterizare de MATERIALE SINTERIZATE NANOSTRUCTURATE

□ Ingineria tesuturilor dure: biocompozite HAP/Ti obtinute prin TSS

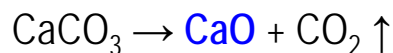
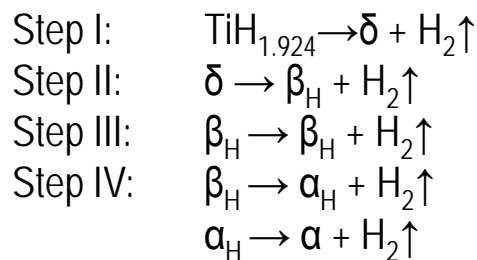
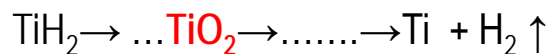


Teisanu C, Ristoscu C, Sima G, Bucse I G,
Olei B-A, Gingu O, *Int. Conf. BRAMAT 2015, Brasov, Romania, 2015*



3. Elaborare si caracterizare de MATERIALE SINTERIZATE NANOSTRUCTURATE

□ Ingineria tesurilor dure: biocompozite HAP/Ti obtinute prin TSS



Sample code	Chemical composition of TSS parts [%wt]				
	C	O	P	Ca	Ti
1.n II	6.07	40.50	11.27	27.63	14.44
3.μ II	4.27	36.45	16.85	37.29	4.94

Sample code	Chemical composition of TSS parts [%wt]				
	C	O	P	Ca	Ti
2.n I	5.27	35.85	14.37	35.25	9.09
3.μ I	4.74	37.14	16.44	36.37	5.07

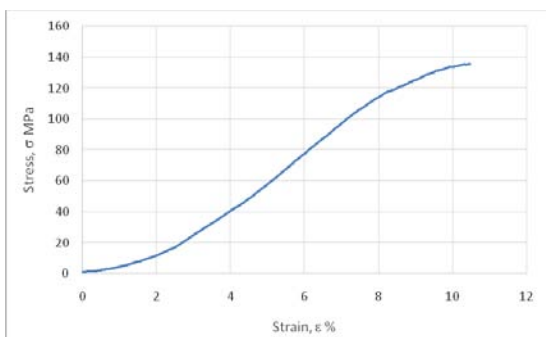
Pascu CI, Gingu O, Rotaru P et al., JOURNAL OF THERMAL ANALYSIS AND CALORIMETRY, Volume: 113 Issue: 2 Pages: 849-857, 2013

Liu H, He P, Feng JC, Cao J. Kinetic study on nonisothermal dehydrogenation of TiH_2 powders. Int J Hydrogen Energy. 2009;34:3018-25.

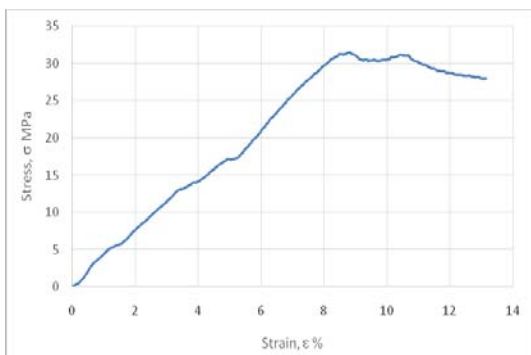


3. Elaborare si caracterizare de MATERIALE SINTERIZATE NANOSTRUCTURATE

□ Ingineria tesurilor dure: biocompozite HAP/Ti obtinute prin TSS



C	O	P	Ca	Ti
5.27	35.85	14.37	35.25	9.09

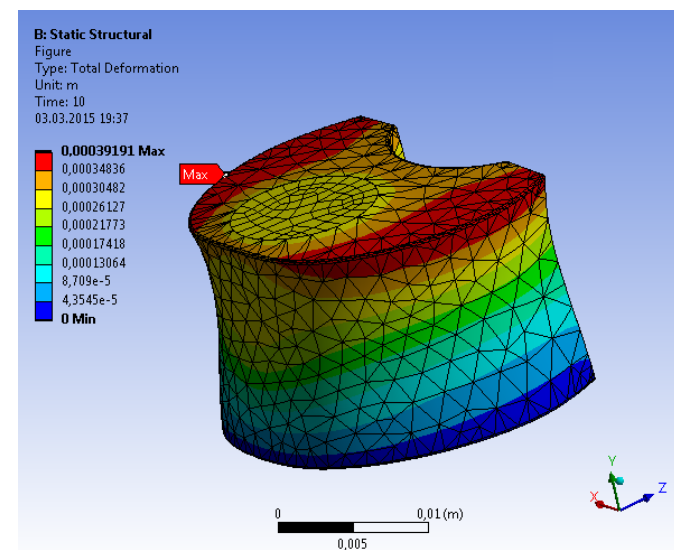
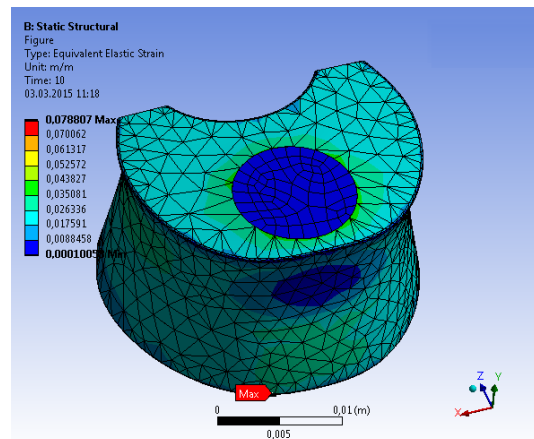
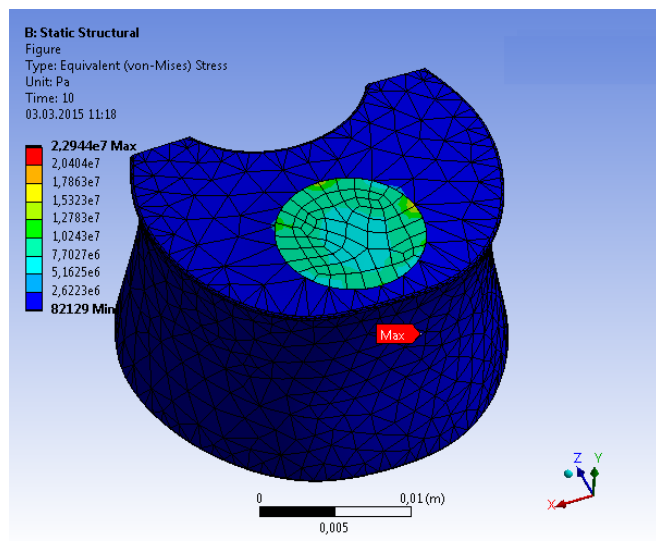


C	O	P	Ca	Ti
4.27	36.45	16.85	37.29	4.94

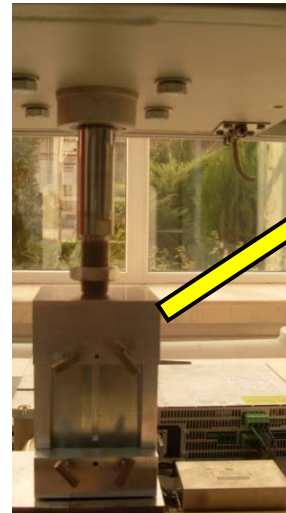
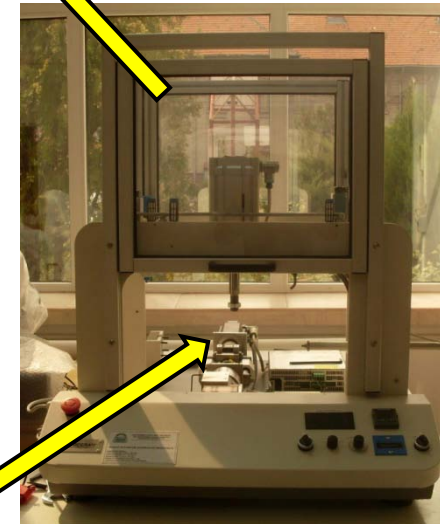
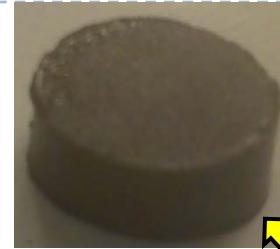
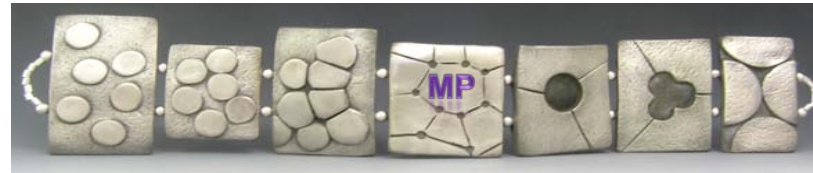
G SIMA, D Cojocaru, IG BUCȘE, B-A OLEI, C TEISANU, O GINGU, Int. Conf. BRAMAT 2015, Brasov, Romania, 2015



4. Modelare si simulare a comportamentului mecanic al MATERIALELOR SINTERIZATE NANOSTRUCTURATE



Coman D, Gorgan M R, Brehar F M, Gingu O,
Int. Conf. BRAMAT 2015, Brasov, Romania, 2015



5. Directii viitoare

**Micro injectie de pulberi
metalice/ceramice/compozite**



5. Directii viitoare

Sinterizare cu incalzire in camp de microunde
a produselor miniaturale formate prin injectie de
pulberi metalice/ceramice/compozite





Mulumiri adresate colaboratorilor si partenerilor de cercetare



PN-II-PT-PCCA-2013-4-2094, title: "Research on the bone substitution with biocomposite materials processed by powder metallurgy specific techniques", acronym **BONY**
2014-2016

NANOALLOY , MP0903 COST Action
2010-2014