

Superconductivity, Spintronics and Surface Science Center

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History

The Center of Superconductivity, Spintronics and Surface Science (C4S) includes the former Material Science Laboratory, created in 1995 within the **Technical University of Cluj-Napoca (TUCN)**; <u>http://www.c4s.utcluj.ro</u>



C4S staff

- •4 Prof/Senior Researchers
- •6 permanent young researchers
- •8 PHD students
- •2 Postdocs
- •2 technicians



Thin film elaboration

UHV sputtering equipment

6 targets, base pressure 2e-9 Torr



Equiped with:

- 2 digital fluxmeters,
- Substrate heater (20-1000 °C)
- Residual gas analyzer (Stanford QMS-200)
- Cryogenic cooling pannel

Ar plasma furnace



E-beam evaporation plant

8rotatable crucibles, base pressure 2e-9 Torr





Vibrating sample magnetometer (Lake Shore): vector field option, variable temperature range (77-1000K)



Magnetic characterization, anisotropy analysis

Chemical deposition tools



Laminar flow fume hood for the chemical deposition of thin films equipped with spinner, dip-coater and ultrasound baths



Tube furnaces up to 1600°C with controlled atmosphere (oxygen, nitrogen, argon).



Rotary Evaporation by BUCHI with Vacuum Pump V-700.

- heating bath can be adjusted from +20 $^{\circ}\mathrm{C}$ to +180 $^{\circ}\mathrm{C}$

- rotation speed 20–240 rpm Programmed vacuum (vacuum limit 10⁻⁷ Torr) or controlled atmosphere tube furnaces up to 1600°C

Argon line for the synthesis of the moisture sensitive precursors





Characterization tools

High Resolution X ray Diffraction D8 Discover (Bruker)



Structural characterization



Atomic Force Microscopy

Nanoscope Dimension 3100 - multimode Operating modes AFM, MFM, EFM, C-AFM ...



Topologic, micromagnetic, local electric characterization



Characterization tools

Cryogen- free system with cryostat and VTI 1.8-300K and up to 7T magnetic field, sample rotation option



Magneto-electric characterization in variable field and temperature





Clean room facilities (class 100):

-Optical lithography (MBJ4 SUSS mask aligner); -Ion Beam etching assisted by Auger Spectroscopy -Chemistry laboratory facilities for nanolithography







Optical lithography (UTCN)











Undercut Neg ma-420

Patterning of:

-Micrometric size magnetic objects -Current in plane electric devices (Hall, GMR, superconducting lines) -Current perpendicular to plane devices magnetic tunnel junctions, superconducting spin valves



Co₂FeAI based epitaxial MTJs

•Co₂FeAI (CFA) theoretically 100% spin polarization

Expected large TMR effect





Epitaxial growth by 45° in plane rotation



Properties of Ni-W/CeO₂/YSZ/CeO₂/YBCO coated conductors







Self assembled Polystirene ball masks





Magnetic vortex



Self organized spheres as shadow masks for IBE of complex MML stacks







Variable shape $=f(\theta)$ MML nanostructures



Circles, antidots: etching 15°



Chains + constrictions (DW manipulation) (variable angle etching)



Hexagones, dots, triangles ...





CFA 10 nm ETCHING 30°

Towards local CPP characterization





MTJ, CPP-GMR, Nano-oscillators...

Ongoing research projects



C4S Research projects (1995-): 9 International, 13 Euro FP, 10 national

Nr	Period	PROJECT TITLE		
1	2012- 2016 FP7	European development of Superconducting Tapes: integrating novel materials and architectures into cost effective processes for power applications and magnets. (EUROTAPES)		
2	2010- 2013	Development of spintronic devices at mezoscopic scale. POSCCE CTR.205/20.07.2010		
3	2010- 2013	Doping and size effects on the magnetic, structural and morphological properties and spin dynamics in micro and nanostructured ferromagnetic oxides. PN II-Complex Exploratory Research Projects, Financed by the Romanian Ministry of Education and Research PNI-ID106, PCCE Nr.4/2010		
4	2010- 2013	<i>From micro to macro - continuum scale modeling of advanced materials in virtual fabrication,</i> PN II-Complex Exploratory Research Projects, Financed by the Romanian Ministry of Education and Research. PNII-ID100, PCCE Nr.6/2010.		
5	2012- 2015	Thick YBCO films with improved superconducting characteristics for coated conductors applications. PNII PT_PCCA-2011-3		

ISI Publications C4S	/ MSL (over 100)	http://www.c4s.utcluj.ro/	
<u>2012</u> (12)	<u>2010</u> (8)	<u>2008</u> (12)	<u>2006-Prev</u> (40)
<u>2011</u> (10)	<u>2009</u> (7)	<u>2007</u> (11)	

Collaboration potential



- > HTcS superconducting materials and applications
- Spintronics and magnetic materials
- > Thin films deposition (chemical and physical method) and characterization
- > Advanced multifunctional materials (bulk, thin films and nanoparticle)

Thank you for your attention!