# Infrastructura de cercetare si potentialul stiintific asociat

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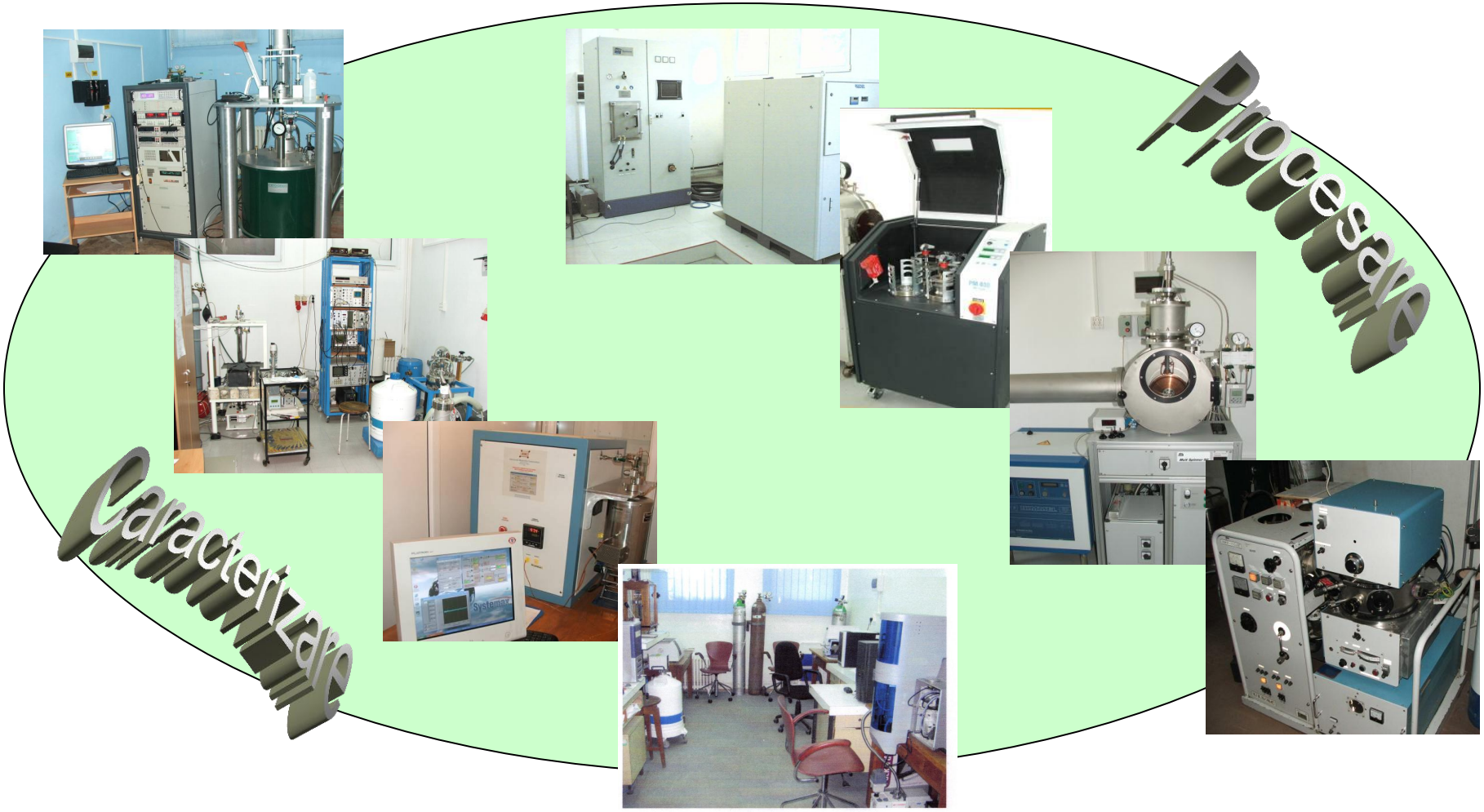
# Laboratorul 20 : Magnetism si Supraconductibilitate



# Tematici abordate:

**Nanostructuri cu raspuns la stimului magnetici. Structuri supraconductoare. Procese fundamentale si aplicatii.**

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*1. Nanostructuri magnetice pentru magneti permanenti*

- •Exchange-spring magneti (nano-compozite si multipaturi).
- •Nanostructuri cu anizotropie de forma
- •Magneti moleculari

*2. Sisteme de nanoparticule magnetice dispersate in diverse medii*

- •Nanoformatiuni magnetice dispersate in matrici metalice/semiconductoare/polimeri
- •Nanofluide magnetice

# Tematici abordate:

**Nanostructuri cu raspuns la stimului magnetici. Structuri supraconductoare. Procese fundamentale si aplicatii.**

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*3. Structuri supraconductoare*

- •Monocristale Bi: 2212, La2-xSrxCuO4 (subdopate, dopate optim si supradopate)
- •Straturi epitaxiale YBa2Cu3O7 (dopate optim si subdopate), supraretele YBa2Cu3O7/PrBa2Cu3O7
- •Diagrame de faze de vortexuri si dinamica vortexurilor in HTS
- •Cresterea densitatilor critice de curent in straturi subtiri YBa2Cu3O7 prin introducerea de defecte columnare (BaZrO3); Cresterea densitatii critice de curent in MgB2 prin dopare controlata (C60);

*4. Nanostructuri magneto-functionale*

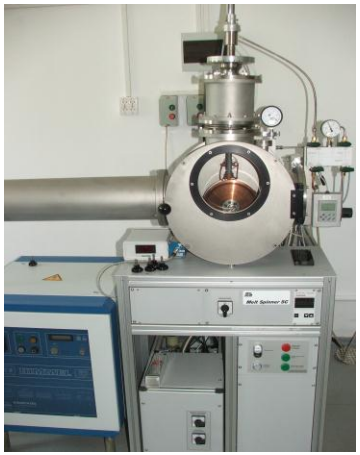
- •Nanostructuri magneto-conductive, magneto-elastice, magneto-calorice, materiale magnetice cu memoria formei
- •Nanostructuri multifunctionale (structuri heterogene bazate pe interfatarea a doua materiale functionale, din care cel putin unul sa fie magneto-functional). La acest punct intra si interfatarea unui material magnetic cu unul supraconductor

# Obtinerea de materiale avansate

# Preparare si procesare

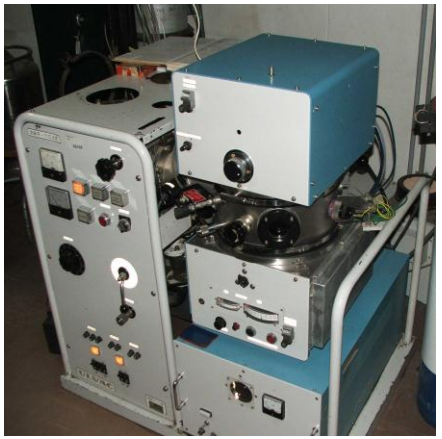
**Tehnologii neconventionale:**

**Cuptoare inductive si in arc, Solidificare ultrarapida din topitura, Co-depunere in radiofrecventa (straturi subtiri), Aliere mecanica (nanopulberi)**



Melt spinning

high energy ball milling

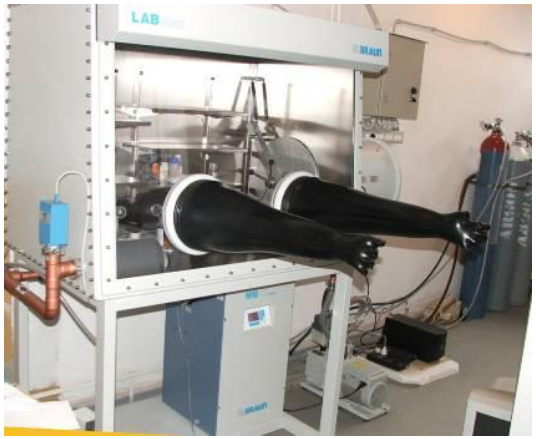


rf sputtering

# Procesare nanostructuri

**Tratament termic cu/ fara camp magnetic aplicat**
**Reactii controlate in gaz, cinetici de absorbtie/desorbtie**


Gas reaction controller

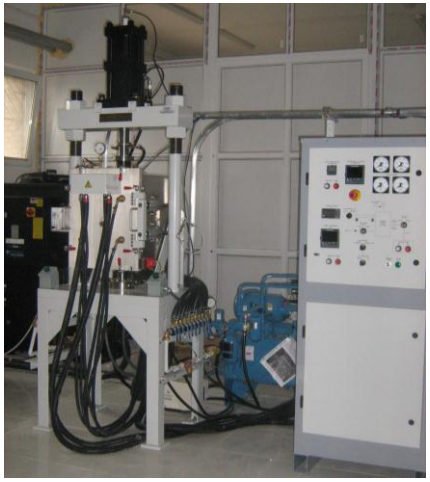



Glove box

# Procesare nanostructuri:

## Laborator de Infrastructura de Procesare in Conditii Extreme

### Hot Press Sintering

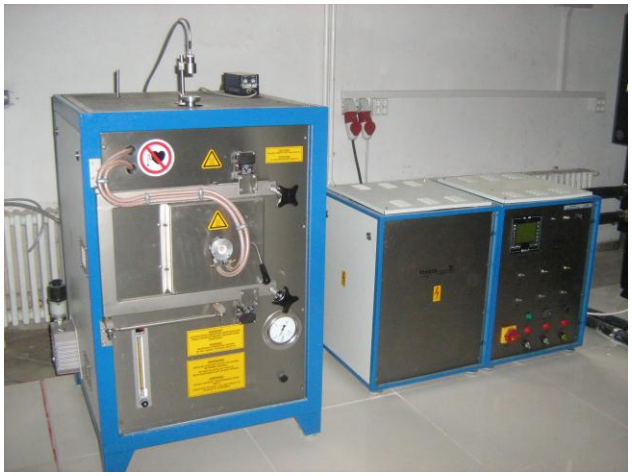


**Achizitionat MRF, USA, 2009**

**Main features:**

Maximum batch furnace temperature: 2300 C
Maximum "hot press" temperature: 2200 C
Increasing temperature at 100 C/min.
Max. stroke force 100 kN, above 1000 C
Max. stroke distance: 4" with ΔF = 44 N
Ar or vacuum sintering (10-3 mbar)

### Microwave Sintering



**Achizitionat LINN, Germany, 2009**

**Main features:**

Work space: 135 mm x 135 mm x 135 mm
6 magnetrons, maximum power 4.8 kW
Frequency: 2450 MHz
Maximum sintering temperature: 1700 C
Ar, N2 sintering or vacuum (~10-3 mbar)
Susceptors for pre-heating of difficult materials
Arbitrary samples shapes
**also metallic materials !**

### Spark Plasma Sintering

**Achizitionat FCT, Germany, 2008**

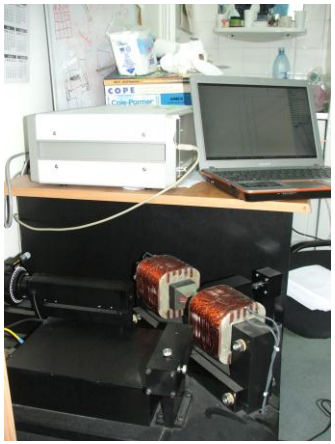
**Main features:**

Direct (pulsed) current heating
Impulse bursts programmable
Maximum furnace temperature: 2400 C
Maximum working temperature: 2200 C
Increasing temperature max 400 C/min.
Max. force 50 kN or max. pressure 200 bar
Max. stroke distance: 85 mm
Ar or N2 sintering

# Caracterizare proprietati:

## Infrastructura Integrata pentru Caracterizari Electro-Magnetice

**Magnetic and electric characterization**

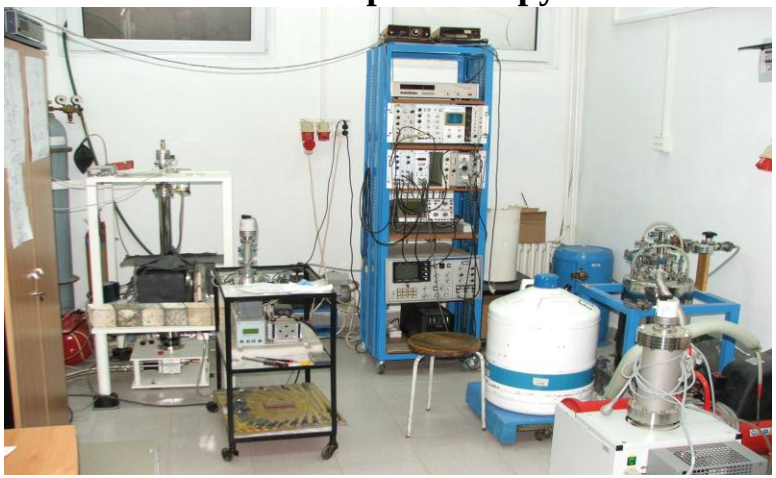


**HT Cryogen Free System**, 1.5 K-300 K and up to 9 T
- Sensitivity: $10^{-5}$ emu (VSM) and $10^{-7}$ emu (AC)
- 4 points measurement for resistivity for up to 4 samples
- 6 points measurement for Hall effect
- furnance for high temperature magnetometry up to 600 K

-high pressure magnetometry, Seebeck coefficients, thermal conductivity for bulk and thin films

**MOKE:** 0.5 T and a sensitivity of a few monolayers

**Mossbauer Spectroscopy**



The **whole range of Mossbauer spectroscopy techniques** are available:

• Temperature dependent Mossbauer spectroscopy in transmission geometry (close cycle cryostats for measurements down to 4.5 K and ovens for measurements up to 1200 K)

• Conversion Electron Mossbauer Spectroscopy for surface analysis (in applied field and temperature dependent)

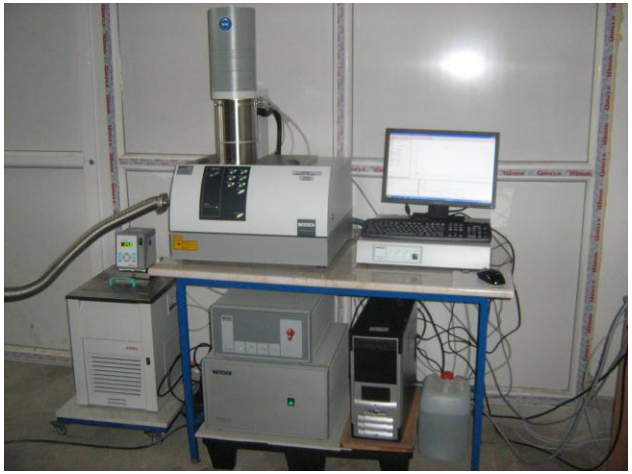
# Caracterizare termica:

## Thermal Analysis Module

**1. Perkin Elmer Diamond Thermogravimeter: 20°C – 1550°C;**
**2. Netsch Differential Scanning Calorimeter: -180°C – 700°C;**
**3. SETARAM DTA/DSC Thermogravimeter: 20°C – 1750°C**

Temperature range: -150 to 1700oC
Crucible volume: 30-100 µl
Scanning rate: 0.01-100°C/min
The different measurement modules (DTA, DSC, TGA) can be adapted interchangeably around the same structure
Determination of onset, peak, inflection and end temperatures
Transformation enthalpies: analysis of peak areas
Evaluation of crystallization, glass transition analysis

## Thermal Constants Analyzer



- Laser Flash system (Nd-GGG)
- Infrared detector InSb
- Tubular furnace, termocouple measurement
- Measurement temperature range : 20 - 1100 C
- Thermal diffusivity: 0.01-1000 $mm^2/s$
- Thermal conductivity: 0.1-2000 W/m/K
- Specific heat by a differential method
- Multilayers sample measurement
- **Nondestructive investigations**
- Flexible measurement, fully automatic
- Integrated software for analysis

# Finantare

**Proiecte 2008-2012 castigate prin competitie:**

- **1** Proiect FP6 - Network of Excellence (MagMaNet) 150 kEuro.
- **12** Proiecte PARTENERIAT (3 Director, 9 Partener): 800 kEuro
- **5** Proiecte IDEI: 900 kEuro
- **5** Proiecte Euratom: 150 kEuro
- 7 Proiecte de Cooperare Internationala (Modul III): 220 kEuro

# Output 2008-2012

- 25 articole stiintifice in jurnale cotate ISI Impact factor mediu/publicatie → 2.
- 5 patente acordate/depuse,
- 3 contributii in volume editate international
- 10 lectii invitate
- peste 20 prezentari orale la conferinte internationale

# Challenge

- Revelarea potentialului infrastructurii CDI catre mediul economic (mecanisme: transfer of knowledge, transfer tehnologic)
- Corelarea politicilor de dezvoltare a infrastructurii cu cele de resurse umane (incetinirea brain-drain-ului, atragerea de cercetatori tineri cu potential ridicat)

# INCDFM; Magnetism si Supraconductibilitate

Multumesc pentru atentie !