National R&D Institute for Non-ferrous and Rare Metals

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Contact: Director Dr.Eng.Teodor Velea, e-mail : tvelea@imnr.ro
Address: 102 Biruintei B-ld , Com. Pantelimon, Jud. Ilfov; Phone/fax: (401) 352 20 48

Nanostructured Materials Laboratory

Main research topics:

• Wet chemical synthesis of nanocrystalline ceramic powders (co-precipitation, sol-gel colloidal from inorganic precursors, hydrothermal)
• Chemical synthesis of hybrid inorganic-organic nanomaterials by in-situ functionalisation
• Synthesis of ceramic matrix composite nanomaterials
• Synthesis of core/shell structured powders
• Development of chemical processing for thin/thick nanocrystalline ceramic films: sol-gel, hydrothermal/electrodepositing processes
• Processing of ceramic and composite powders
• Fundamental studies on the mechanisms and kinetics of the synthesis processes.

Main equipments:

• **Computer-controlled hydrothermal-electrochemical system for synthesis of nanopowders and electrodepositing of thin films (*Unique in Europe*)**

- Teflon autoclave 2.2L (CORTEST, USA), max. temperature 304°C, max. pressure 2500 atm.
- Potentiostat/galvanostat Radiometer PGZ100/Voltalab 10 and HVB100 booster (U max ∓ 100 V)

• **Sol-gel colloidal synthesis pilot plant:**

- Glass reactors (50L), high capacity electromechanical stirrer
- Stainless steel filter with vacuum pump;
- Laboratory centrifugal separator;
- Computer-controlled pH-meter/conductometer Jenway 4330
- Water distiller Bibi Stirling, Anglia, 4 l/hour
- Magnetic stirrers with heating system, capacity 10L, Heidolph
- Spin coater system, digital control of speed (1000-2000 and 1500-8000 rpm), vacuum pump 150l/hour at 200 mbar

• **Powders processing equipments:**

- Laboratory hydraulic press 25 tf
- Laboratory tape casting machine for thin ceramic membranes
- Chamber furnace CARBOLITE, with EUROTHERM digital controlled up to1700^{o}C in air and controlled atmosphere
- Vacuum furnace DEGUSSA, max. temp 18000C, vacuum level 10-4 to 10-6 bar;
- Continuos countercurrent tubular furnace contracurent, max. Temp. 1200°C;
- Pascal ceramic balls milling system, volume 2 l/vessel;
- Powders homogenizer TURBULA;

• **Software:**

- Soft for thermodynamic and equilibrium calculations HSC 4 Outokumpu Oy, Finland;
- Soft VoltaMaster 4/VOLTALAB 10 for electrochemical and corrosion processes;

Some important achievements:

• Hydrothermal synthesis processes for high purity, YSZ and YTZP zirconia nanopowders for sensors and fuel cells;
• Sol-gel colloidal and hydrothermal synthesis processes of doped (Ba,Sr)TiO3 ultra disperse ceramic powders and films;
• Synthesis of Pb(La,Sn)ZT doped ultradisperse powders;
• Thin nanostructured doped PZT films by hydrothermal or electrodepositing methods;
• Synthesis of metallic core/ceramic shell structured powders for coatings and sintered compacts;
• Hydrothermal synthesis of pure and zirconia-doped hydroxy-apatite(HAP) powders;
• Hydrothermal synthesis of hybrid HAP-polymer nanocomposites;

Recent publications:

1. R.R. Piticescu, R. M. Piticescu, D. Taloi, ***"Modelling hydrothermal synthesis of ceramic nanocomposite powders",*** Solid State Phenomena, ISSN 10120394, pp.165-170 (2003)
2. Roxana M. Piticescu, R. R. Piticescu, D. Taloi, V. Badilita ***"Hydrothermal synthesis of ceramic nanomaterials for functional applications"***, Nanotechnology vol. 14, no. 3, February 2003
3. R.R. Piticescu, B. Malic, M. Kosec, A. Motoc,C. Monty, I. Soare, T. Kosmac, A. Daskobler, ***"Synthesis and sintering behaviour of hydrothermally synthesised YTZP nanopowders for ion-conducting applications",*** J. Eur. Ceram. Soc. Vol. 24, pp.1941-1944 (2004)
4. R.M. Piticescu, A.M.Moisin, D.Taloi, V. Badilita, I.Soare, ***"Hydrothermal Synthesis of ultradisperse PZT powders for polar ceramics"***, J. Eur. Ceram. Soc. Vol. 24, pp.931-935 (2004)
5. R.M. Piticescu, G.C. Chitanu. M.L. Popescu, W. Lojkowski, A. Opalinska, T. Strachowski, ***"New hydroxyapatite based nanomaterials for potential use in medical field"***, Annals of Transplantation, 9 (1A), 20-25 (2004)
6. Roxana M.Piticescu, Gabrielle Charlotte Chitanu, Mihaela Albulescu, Maria Giurginca, Madalina Laura Popescu, Witold Lojkowski, ***"Hybrid HAp-maleic anhydride copolymer nanocomposites obtained by in situ Functionalisation"***, Reviews on Advanced Materials Science 8[2],164-169 (2004)
7. Roxana M. Piticescu, L. Mitoseriu, M. Viviani, V.Moagar Poladian, ***"Preparation and Characterisation of $Pb(Zr_{0.52}Ti_{0.48})_{0.975}Nb_{0.025}O_3$ ceramics"***, J.Eur.Ceram.Soc.25, 2491-2494 (2005)
8. Roxana M.Piticescu, Gabrielle C. Chitanu, M. Albulescu, M. Girurginca, Madalina L. Popescu and W. lojkowski, ***"Biocompatibility of thin films based on hydrothermal synthesized Hap", in "From Nanopowders to Functional Materials"***,pp.47-56, ed. By Robert Piticescu, W. Lojkowski and John.R.Blizzard, Trans Tech Publications, ISSN 1012-0394 (2005)
9. R.R. Piticescu, C. Monty and L.Grigorjeva, ***"Hydrothermal synthesis of nanostructured zirconia materials: state of the art and future prospects",*** Sensor and Actuators B, vol 109, No. 1, pp102-106 (2005)

Participation to international contracts:

• NATO SfP 974054 ***"Zirconia Nanomaterials"*** (2000-2004)
• European PHARE ***Technology Transfer and Quality Management*** 1135 (2000)
• G5RT-CT-2001-05024 ***European Network Polar Electronic Ceramics-"POLECER"*** (2001-2006)
• GRD1-99-1-1008V-1 ***"Microscale fabrication of functionally graded materials"***
• COST D30 -***"High Pressure Synthesis of Nanomaterials",*** member in management committee (2004-2006)
• COST 525–"***Advanced Electroceramics: Grain boundary engineering"***, member in management committee (2004-2005)
• G5ST-CT-2002-50328 ***Craft METMICOATED*** (2003-2005)
• ***SOLFACE –Optonanos***, FP6 Infrastructure Project (2004-2005)
• ***ECO-NET "Functional Nanomaterials"*** (2005-2006), project managed by EGIDE France, coordinated by CNRS/PROMES Odeillo-Font Romeu, with participation of research groups from Romania, Poland and Latvia.

The Nanostructured Materials Group is member in the ***"Romanian Technological Platform for Nanomedicine" RO-NANOMED. Services offered by IMNR in the frame this poject:***

• **Access to equipments**
• **Assistance for the following activities:**

- *Functionalized nanoparticles synthesis by sol-gel and hydrothermal processes*
- *Thin films obtaining by hydrothermal-electrochemical and electrophoresis techniques*
- *Obtaining of compact sintered layers*
- *Methods for complete chemical analysis*
- *Training and educational activities*
- *Dissemination and protection of property rights, promotion of participation to international and European projects by collaborating with CTT AVANMAT and CTT Baneasa*

Contacts: Dr.Roxana Mioara Piticescu e-mail : roxana@imnr.ro; **Dr. Radu Piticescu**, e-mail : rpiticescu@imnr.ro
Address: Bd. Biruintei 102, Pantelimoun, Ilfov, Romania; Phone/fax: 0040 21 3522048; 0040 21 3522045;