NATIONAL INSTITUTE OF MATERIALS PHYSICS BUCHAREST-MAGURELE

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The **National Institute of Materials Physics** is the successor of the Bucharest Institute of Physics founded in 1956 and led by professor Eugen Badarau. In its present location, Magurele, the Institute moved in 1974, in 1977 being named **Institute of Physics and Technology of Materials**. The present name **National Institute of Materials Physics**, was given in 1996 after a national accreditation procedure.

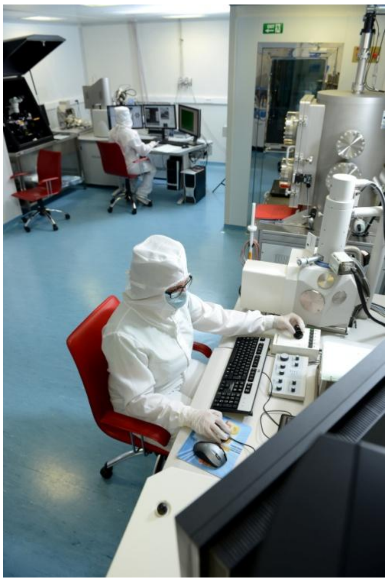
Our Mission

The **National Institute of Materials Physics** has as main goals basic and applied research in the field of materials and condensed matter physics.

Preparation, characterization and understanding of new materials with high economic impact potential are carried out using state of the art equipment by an experienced staff of about 150 researchers.

National and international partnership with both academic and industrial partners is pursued and led to complex, high level research. The Institute constantly employs young graduates, helping them in their scientific development and in establishing solid research careers.

An output of more than 180 scietific papers most of them in well known scientic journals are published every year.



A wide range of preparation techniques is available, permanently new materials being created by the Institutes research teams. Thin films ranging from transparent conducting oxides, organic semiconductors or ceramics to magnetic metals are prepared by physical deposition methods such as Pulsed Laser Deposition, vacuum evaporation or magnetron sputtering.

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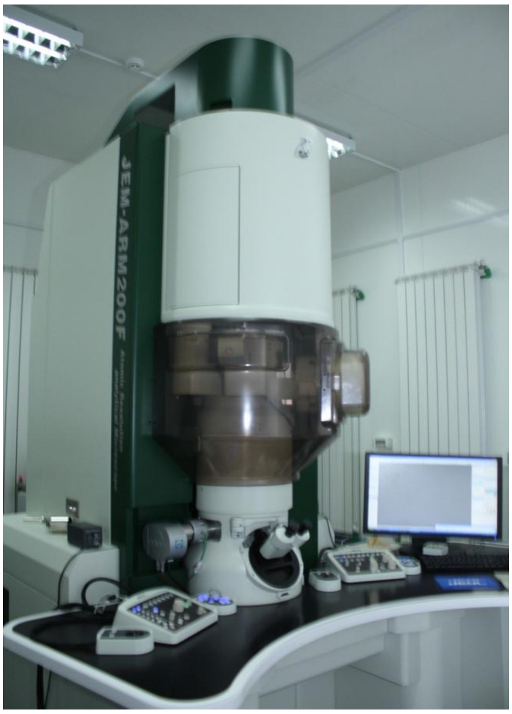
Wet chemistry preparation methods are among the more convenient in terms of cost and scalability. Fully equipped chemistry laboratories are available. Research staff is experienced in methods such as: sol gel deposition, chemical bath deposition, electrochemical deposition, Langmuir – Blodgett and spin coating for a wide range of materials.

Different sintering methods are available (Hot-Press, Microwave Sintering, Spark Plasma Sintering), and allow the preparation of a wide range of materials with applications ranging from magnetic sensors to fusion reactors.



Morphologic and structural characterization of materials is performed through a wide range of methods, from scanning and transmission electron microscopy down to atomic resolution to X ray and electron diffraction.

Compositional characterization is also a key element and is performed through methods ranging from X Ray Photoelectron Spectroscopy to X Ray Absorption Fine Structure. The XPS Cluster represents one of the most complex such systems in Europe, making possible the preparation and characterization in situ of surfaces and interfaces

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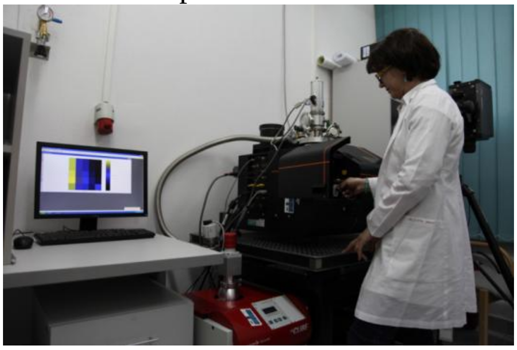
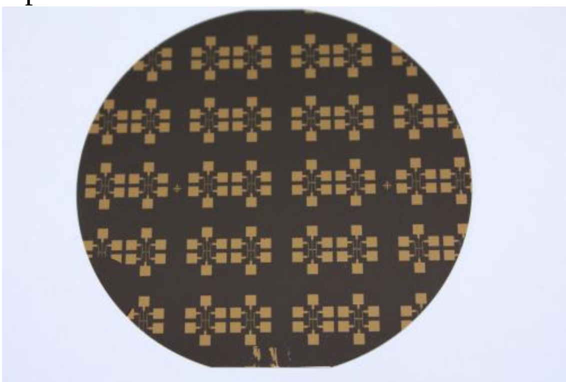
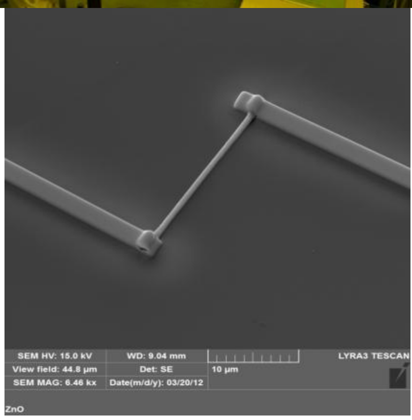
Different Magnetic Properties Measurement Systems, such as vibrating sample magnetometer or SQUID allow research on magnetic materials, spintronics and supraconductors.



Raman spectrometers, fluorescence and near field spectrometers and microscopes allow complex characterization of materials for optics, photonics and optoelectronics





A cleanroom class 100 and class 1000 (ISO 5 and ISO 6, respectively) allows the transition from materials to devices:
The cleanroom is equiped with photolithographic equipment, an electron lithography system with laser interferometer stage positioner, a dual beam e beam and ion beam system and a characterization microprobe station.

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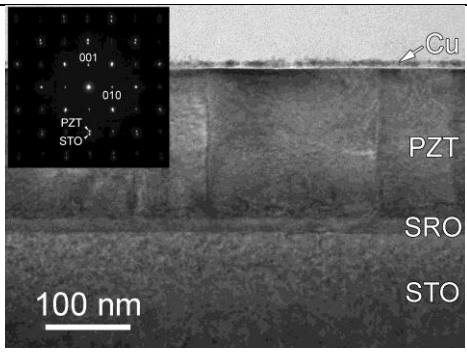
"Development of the synthesis procedures and optical characterization of composite materials based on carbon nanoparticles and polymers for applications in the energy storage field".

This topic has been developed in the frame of two national projects (IDEI 72-182/2008 and IDEI 150/05.10.2011) financed by UEFISCDI and an international project SCOPES (IZ74ZO_137458) financed by Swiss Science Foundation. Some significant results obtained are: **a**) the elucidation of mechanisms concerning electrochemical functionalization of single-walled carbon nanotubes (SWNTs) with different conjugated polymers such as polybithiophene (**Carbon**, 47, 1389-1398,2009), poly(3,4-ethylenedioxythiophene) (**J. Mater. Chemistry** 19, 5690, 2009), etc. using investigation techniques such as surface enhanced Raman scattering (SERS), photoluminescence, FTIR and UV-VIS-NIR spectroscopy; **b**) anti-Stokes/Stokes Raman scattering manifesting as a non-linear optical process is evidenced in poly(3,4-ethylenedioxy thiophene)/ SWNTs composite (**J. Raman Spectroscopy** 42, 3030-312, 2011); **c**) new evidences concerning the interface reactions, between the poly(p-phenylenevinylene)/single-walled carbon nanotube composite and SERS active supports using the infrared dichroism studies (**The Journal of Physics Chemistry C** 116, 25537, 2012); **d**) new non-linear optical processes of the type anti-Stokes luminescence in the poly-paraphenylene vinylene/carbon nanotubes composite (**Journal of Applied Physics** 111, 083109, 2012); **e**) Casimir effect demonstrated by Raman spectroscopy on tri-layers grapheme intercalated into stiff layered structures of surfactants (**Carbon** 51, 134, 2013); **f)** using composites of the type poly(3,4-ethylenedioxy thiophene)/ SWNTs (**Current Organic Chemistry** 15, 1160, 2011) and polydiphenylamine/ SWNTs (**Mat. Science Engineering B – Advanced functional solid-state materials** 985, 211, 2011) as active materials for electrodes of rechargeable lithium batteries; and **g**) using of the single-walled carbon nanotubes functionalized with polydiphenylamine as active materials for applications in the supercapacitors field (**Diamond and Related Materials** 32, 72, 2013).

Studying interfaces in oxide based heterostructures
FP7 project „Interfacing oxides" (IFOX)
Period: 2010-2014
http://www.ifox-project.eu
16 partner institutions from 8 European countries. Industry represented by Fiat, Organic Spintronics (Italy) and TSST (the Netherlands). The total budget is over 15.5 millions euro (11.3 millions from the European Comission), from which the Romanian partner NIMP has 576,200 euro (434,400 from the Comission).

Complex Exploratory Research Project „Effect of interfaces on charge transport in ferroic/multiferroic heterostructures" (PCCE contract no. 3/2012)
Period: 2012-2015; http://www.infim.ro/projects/efectul-interfetelor-asupra-transportului-de-sarcina-heterostructuri-feroicemultiferoice
5 research teams from NIMP and 1 from the „Alexandru Ioan Cuza" University, Iassy. Total budget is 7 millions lei (about 1.55 millions euro) from which 6.51 millions are for NIMP (1.44 millions euro).



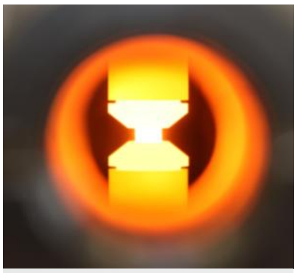
17 published or accepted for publication papers, 1 book chapter

- Deposition of high quality epitaxial ferroelectric films
- Complex investigation of the electrode-ferroelectric interface by combined electric and XPS measurements; demonstration of the direct influence of the polarization on the barrier height and energy band bending at the interface

Ştiinţa Suprafeţelor şi Interfeţelor: Fizică, Chimie, Biologie, Aplicaţii

The project, led by the National Institute of Materials Physics offered the support for a decisive development of Surface Science in Romania. Themes from physics and chemistry of surfaces are approached together with aplications in surface sciences in byology and technology, new standards being developed for a consistent interpretation of experimental data. The project brought together the most important Romanian teams with interest in surface sciences, particularly all the teams with XPS expertise together with the most important part of teams with results in thin film deposition, cluster physics and nanoparticles, surface reactivity, chemistry and photochemistry of surfaces, multilayers physics and applications, magnetic fluids, functional surfaces, cell adhesion, cell membrane studies. The research teams involved are led as stated by the team of Cristian Teodorescu from the National Institute of Materials Physics and are members of the most relevant Universities and Research Institutes in the country.

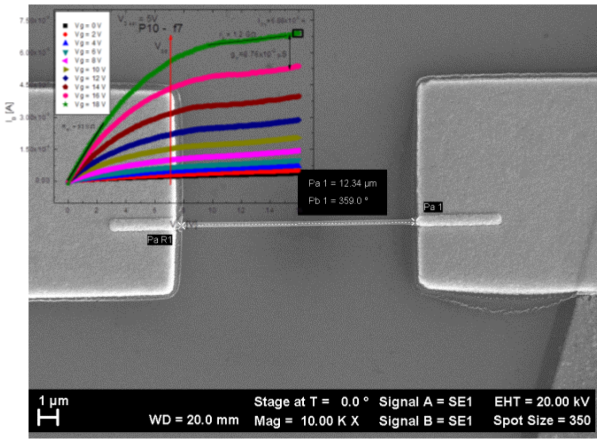
During 30 months, the project exceeded most of the relevant contractual figures (number of published papers, overall impact factor). 8 articles were published in high impact factor journals (> 3: Chem. Mater., J. Appl. Crystallogr., Adv. Funct. Mater. - *Comment*, J. Phys. Chem. C, Appl. Phys. Lett., Phys. Rev. B, Bioelectrochem., J. Nanopart. Res.). The most important result of the project was the creation of a common scientific background, the formation of manpower (about 25 young researchers), together with generation of new knowledge in this area of high fundamental interest and tremendous amount of applications.



Materials and technology development for DEMO fusion reactor

A fusion reactor able to deliver energy to the network needs materials able to withstand high temperature a radiation fluxes. Such materials should have also the capability to quickly transfer heat to conversion systems and create a robust structure sustaining the plasma vessel and the blanket. The available materials and subsequent technologies are not able to provide viable solutions for fusion reactors beyond ITER. NIMP has joined recently the global research effort using its new research infrastructure dedicated to the production and investigation of materials for extreme environments, a large collection of equipments unique in Romania and rarely found even in top research institutes from Europe. Starting with 2009, in the frame of EFDA NIMP has obtained about 640000 Euro to develop materials and technologies related to DEMO development, focused on W based materials and composites, SiC and oxide dispersed strengthened ferritic steels (ODSFS) as well as joining technologies for such materials.

Some of the most relevant results obtained are related to the development of W-steel functionally graded materials -FGM (main figure) with application in armor parts and He cooled divertor (the right inset shows a divertor component created in one step process by SPS) or W-Cu FGMs with applications for the water cooled divertor concept, W-based SiC composites - alternative structural materials and the development of FAST based joining technology for refractory materials.



Nano-objects based electronic devices for sensing applications

The cooperation (5 research teams from Austria, Switzerland, Italy, Germany and Romania) in the framework of **Eurocore projects**, coordinated by the European Science Foundation aims at developing a sensor in the form of a field effect transistor for detecting certain specific molecules in a bio-mimetic way.

The goal of the Romanian team based in the National Institute of Materials Physics is to develop a nanowire based field effect transistor which will become the electronic component of the sensor. This will be further functionalized with bio molecules such as odor binding proteins in order to achieve the desired behavior. Based on its previous expertise a ZnO nanowire transistor was developed in an original manner with state of the art electronic properties. The approach paves the way to further work in developing new electronic devices based on ultraminiaturised components.

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