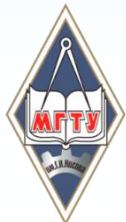


Magnitogorsk State Technical University
named after G.I. Nosov (MSTU), Russia

REPORT ON IMPLEMENTATION OF MMATENG PROJECT BY MESO ACTIVITY



MSTU (P12)
Magnitogorsk, December of 2015

Coordinator MSTU (P12)
Koptseva N.V.©
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MMATENG work group of MSTU



Target institute, faculty and departments responsible for implementation of MMATENG project

- Metallurgy, Mechanical Engineering and Materials Processing Institute
- Standardization, Chemistry and Bioengineering Faculty
- Departments:
 - Foundry and Materials Science
 - Mechanical and Metallurgical Process Engineering
 - Ferrous Metallurgy
 - Technology, Certification and Service of Vehicles
 - Chemistry Department

Related universities and nonacademic partners involved in the project

• Novotroitsk Branch of the National University of Science and Technology MISiS



Новотроицкий филиал

• LLC Research and Manufacturing Plant Foundry and Metallurgy Technologies



• OJSC MMK-METIZ
• CJSC MRK
• etc.



Rudny industrial Institute,
Rudny, Kazakhstan



Analysis of current curricula and disciplines related to the subject of MMATENG

Items	BA	MA
Number of current curricula in the field of MMATENG (total)	16	7
Number of curricula to be analyzed	11	4
Number of analyzed curricula	11	4
Number of curricula to be upgraded/modernized	11	4
Number of current disciplines in the field of MMATENG (total)	over 300	over 150
Number of disciplines to be analyzed	252	46
Number of analyzed disciplines	252	46
Number of disciplines to be upgraded/modernized	12	7

- We **have analyzed** 15 current MMATENG related curricula containing 298 work programs and **selected** 23 disciplines included in licensed BA and MA educational program on “Metallurgy” and “Materials Science and Materials Engineering” for further upgrading
- We **have developed** a schedule of upgrading which provides for accreditation of developed educational programs and the schedule of their implementation (from February of 2015 to September of 2016) in training at 5 departments: Foundry and Materials Science; Mechanical and Metallurgical Process Engineering; Ferrous Metallurgy of the Institute of Metallurgy, Materials Science and Metal Working; Chemistry; Technology, Certification and Service of Vehicles of the Faculty of Standardization, Chemistry and Biochemistry.
- An analytical report (35 pages, 5 tables) **is issued**

List of disciplines to be upgraded and implemented in training at MSTU

The trial training – February 2016

Core curricula

- 1 Materials science
- 2 General materials science and materials engineering
- 3 Simulation and optimization of materials properties and processes
- 4 Constructional materials
- 5 Mechanics of materials and design principles
- 6 Modern structural and tool materials
- 7 Modern materials research methods
- 8 Modern methods of analysis of the structure and metal and alloy properties
- 9 Methods and tools for studies, analysis and diagnostics of nanomaterials
- 10 Mechanical properties of metals
- 11 Metallurgical and machine-building waste treatment
- 12 Processes and equipment for manufacturing of nanomaterials
- 13 Production waste treatment and disposal
- 14 Structure and properties of nanomaterials
- 15 Fundamentals of heat treatment processes at machinery plants
- 16 Fundamentals of heat treatment processes at metallurgical plants

Transferrable curricula

- 17 Innovations management
- 18 Quality management
- 19 Management and marketing

The content of the discipline “Nano materials Technologies”

Themes	Contact work hours				Time and tasks for individual work	
	Lect.	Practic. works	Laborat. works	Total	Individ. work	Tasks
1. General characteristics of nanotechnologies, nanomaterials and nanostructured materials	2	2	-	4	6	study of theoretical material; preparation of practical work
2. Techniques for synthesis and processing of nanomaterials and nanostructured materials	4	2	-	6	6	study of theoretical material; preparation of practical work
3. Basic research methods of nanomaterials nanostructured materials	6	2	8	16	8	study of theoretical material; preparation of laboratory work
4. Deformation methods of producing bulk nanostructured materials	6	2	-	8	8	study of theoretical material; preparation of practical work
5. Structure and mechanical properties of bulk nanostructured nanomaterials	6	2	8	16	8	study of theoretical material; preparation of laboratory work
6. Stability of bulk nanostructured nanomaterials to thermal influences	6	2	8	16	6	study of theoretical material; preparation of laboratory work
7. Application of nanomaterials and nanostructured materials	6	3	-	9	8	study of theoretical material; preparation of laboratory work
Total	36	15	24	75	50	

Laboratory works themes:

1. "The evolution of structure and mechanical properties in the structural carbon steels during deformation nanostructuring by method of equal-channel angular pressing"
2. "The evolution of structure and mechanical properties after annealing of the structural ultrafine grained steel, nanostructured by method of equal-channel angular pressing"
3. "Modern diagnostics of the structure and properties and physical modelling obtaining of UFG structure in steels".

Title page and contents developed training manuals on discipline “Nano materials Technologies”



Nano materials Technologies

Notes and recommendations for the lecturers



Magnitogorsk State Technical University
named after G.I. Nosov (MSTU), Russia

Koptseva Natalia

*Professor of Foundry and Materials Science
Department*

Polyakova Marina

*Associate Professor of Mechanical and
Metallurgical Process Engineering Department*

20 October 2014

CONTENTS

Introduction	5
1 General characteristics of nanotechnologies, nanomaterials and nanostructured materials. Defining Nanomaterials, Nanostructured Materials and Nanotechnology. Classification of Nanomaterials. Peculiarities of the structure of nanocrystalline materials. Properties of Nanomaterials ..	7
2 Techniques for synthesis and processing of nanomaterials and nanostructured materials Vapor-phase synthesis. Liquid phase synthesis. Sol-gel technique. Solid – state phase synthesis Precipitation from solutions. Consolidation of nanopowders	16
3 Basic research methods of nanomaterials nanostructured materials. X-Ray Diffraction for Nanomaterials Characterization. Electronic microscopy. X-ray spectroscopy. Scanning Probe Microscopy (SPM). Surface Analysis Methods.	27
4 Deformation methods of producing bulk nanostructured materials. Torsion under high pressure. Equal-channel angular pressing. Screw extrusion. Comprehensive forging. Other methods based on large plastic deformation	37
5 Structure and mechanical properties of bulk nanostructured nanomaterials. Typical nanostructures and mechanism of structuring. Experimental methods for measuring grain growth. Peculiarities of mechanical properties formation in structural carbon steel in the process ECAP	46
6 Stability of bulk nanostructured nanomaterials to thermal influences Behaviour of nanomaterials and the nanostructured materials when heating. Structural-phase transformations in low and medium carbon steel with UFG structure formed by the method ECAP.	61
7 Application of nanomaterials and nanostructured materials	70

The titles of tutorials prepared for publication under the project MMATENG

Н.В. Копцева, Ю.Ю. Ефимова, О.А. Никитенко

АТЛАС МИКРОСТРУКТУР

Учебное пособие



*Учебное пособие разработано в рамках проекта TEMPUS MMATENG
«Модернизация двух циклов (МА, ВА) учебных планов на основе
компетенций в области материаловедения в соответствии с лучшим
опытом Болонского процесса»*



Магнитогорск 2015

Чуклин М.В., Копцева Н.В., Ефимова Ю.Ю.,
Емалева Д.Г., Барышников М.П., Полякова М.А.

СТРУКТУРА И СВОЙСТВА НАНОСТРУКТУРИРОВАННЫХ УГЛЕРОДИСТЫХ КОНСТРУКЦИОННЫХ СТАЛЕЙ

Учебное пособие

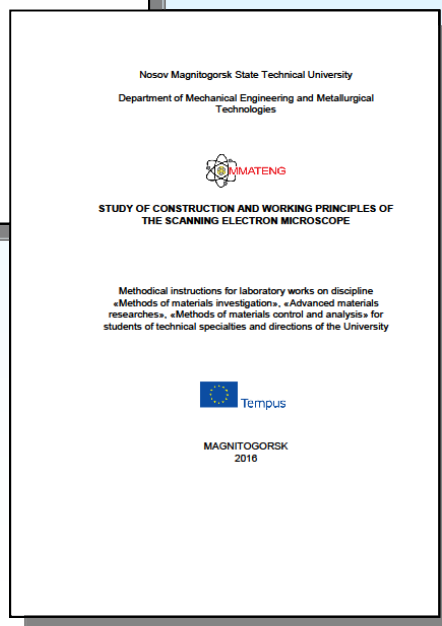
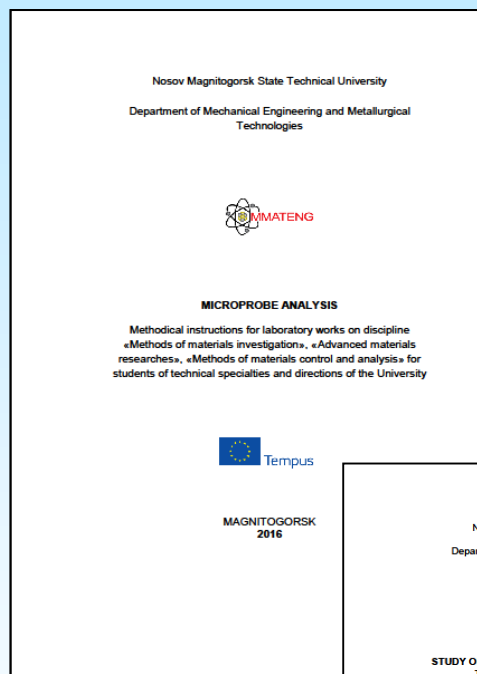


*Учебное пособие разработано в рамках проекта TEMPUS MMATENG
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Магнитогорск 2015

The titles of methodical instructions to laboratory works (in English), developed under the project MMATENG



List of disciplines to be upgraded and implemented in training at MSTU

№	Discipline description at MSTU	Curriculum. Program / Profile of training	Degree	Target Department
<i>Core curricula</i>				
1	Materials science	150400.62. Metallurgy / Metal Science and Heat Treatment of Steel and High-Strength Alloys 150400.62. Metallurgy / Foundry Process 150400.62. Metallurgy / Metal Forming (metalware production) 150400.62. Metallurgy / Functional Materials and Coatings 221700.62. Standardization and Metrology / Standardization and Certification	BA	FMS MMPE FM TCSV
2	General materials science and materials engineering	150100.62. Materials Science and Materials Engineering / Materials Science and Materials Engineering (in machinery) 150100.62. Materials Science and Materials Engineering / Materials Science and Nanomaterials and Nanosystem Engineering	BA	FMS MMPE
3	Simulation and optimization of materials properties and processes	150100.62. Materials Science and Materials Engineering / Materials Science and Materials Engineering (in machinery)	BA	FMS
4	Selection of heat treatment technologies and equipment	150100.62. Materials Science and Materials Engineering / Materials Science and Materials Engineering (in machinery)	BA	FMS
5	Operational materials	190600.62. Operation of Handling and Production Machines and Complexes / Automotive Service	BA	TCSV
6	Mechanics of materials and design principles	150100.62. Materials Science and Materials Engineering / Materials Science and Nanomaterials and Nanosystem Engineering	BA	MMPE
7	Modern structural and tool materials	150400.68. Metallurgy / Metal Science and Metal Heat Treatment	BA	FMS
8	Modern materials research methods	150400.68. Metallurgy / Metal Science and Metal Heat Treatment 150400.68. Metallurgy / Metalware Production	MA	FMS MMPE
9	Modern methods of analysis of the structure and metal and alloy properties	221700.68. Standardization and Metrology/ Tests and Certification	MA	TCSV

List of disciplines to be upgraded and implemented in training at MSTU

Continued

№	Discipline description at MSTU	Curriculum. Program / Profile of training	Degree	Target Department
9	Methods and tools for studies, analysis and diagnostics of nanomaterials	150100.62. Materials Science and Materials Engineering / Materials Science and Nanomaterials and Nanosystem Engineering	BA	MMPE
10	Mechanical properties of metals	150400.62. Metallurgy / Metal Science and Heat Treatment of Steel and High-Strength Alloys 150100.62. Materials Science and Materials Engineering / Materials Science and Materials Engineering (in machinery)	BA	FMS
11	Metallurgical and machine-building waste treatment	150400.68. Metallurgy / Ferrous Metallurgy	MA	FM
12	Production waste treatment and disposal	280700.62. Technosphere Safety / Technosphere Safety	BA	Chemistry
13	Processes and equipment for manufacturing of nanomaterials	150100.62. Materials Science and Materials Engineering / Materials Science and Nanomaterials and Nanosystem Engineering	BA	MMPE
14	Structure and properties of nanomaterials	150400.62. 150400.62. Metallurgy / Functional Coatings 150400.62. Metallurgy / Metal Forming (metalware production)	BA	MMPE
15	Fundamentals of heat treatment processes at machinery plants	150400.62. Metallurgy / Metal Science and Heat Treatment of Steel and High-Strength Alloys	BA	FMS
16	Fundamentals of heat treatment processes at metallurgical plants	150400.62. Metallurgy / Metal Science and Heat Treatment of Steel and High-Strength Alloys	BA	FMS
<i>Transferrable curricula</i>				
17	Innovations management	150400.68. Metallurgy / Ferrous Metallurgy	MA	FM
18	Quality management	150400.68. Metallurgy / Metalware Production 150400.68. Metallurgy / Ferrous Metallurgy	MA	FMS FM
19	Management and marketing	261700.62. Graphic Arts and Packaging Technology / Packaging Technology and Design	BA	Chemistry

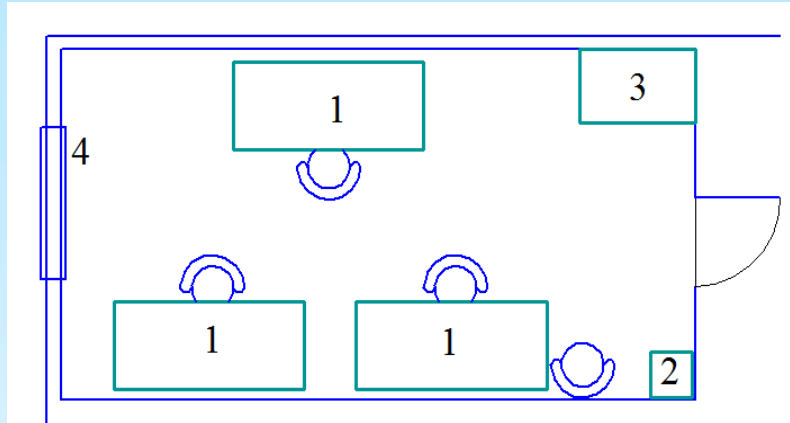
Establishing the Materials Information Technology Lab (MITL) and Material Engineering Service Office (MESO)

Plan of key activities

- To prepare a room for MITL and MESO
- To procure and study opportunities of MITL equipment
- To prepare work schedules of MESO and MITL
- To develop an individual page of MESO and MITL on the website of the university
- To analyze potential services, offered to partner companies, using MITL
- To send information emails inside the university and to interested organizations
- To carry out introductory seminars and a presentation of potential opportunities of MITL for groups of students
- To monitor research projects of students and workgroups showing a potential interest in the use of MITL
- To develop a draft Regulation on MESO



Room for MESO

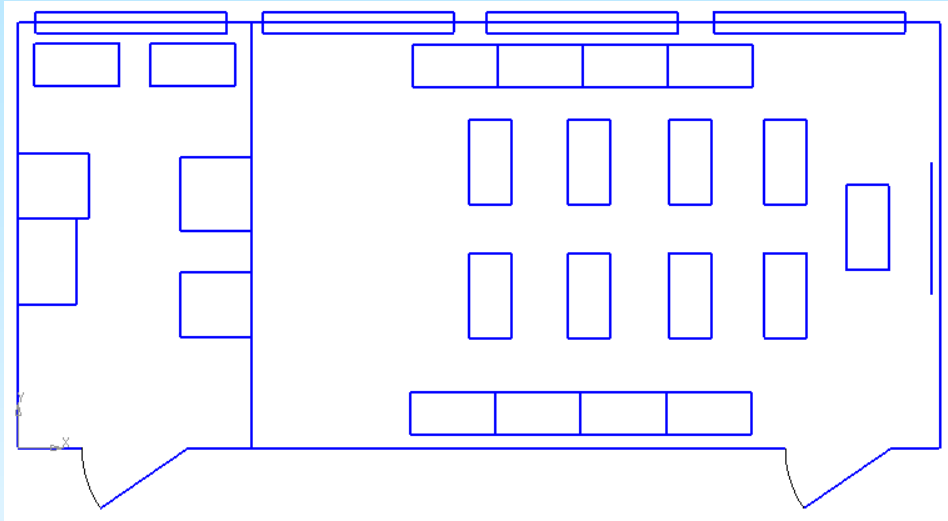


List repair works:

1. Water-emulsion paint of the ceiling;
2. Pasting wallpaper for painting;
3. Linoleum floor covering;
4. Installation of wooden plinths;
5. Installation of PVC window;
6. Installation of wooden door;
7. Two sides painting of door;
8. Installation the cable channel and cabling;
9. Installation of outlets;
10. Installation of one-button switch;
11. Installation of shutters;
14. Preparation of 3 workplace and installation of one of them.



Room for MITL



Laboratory equipment

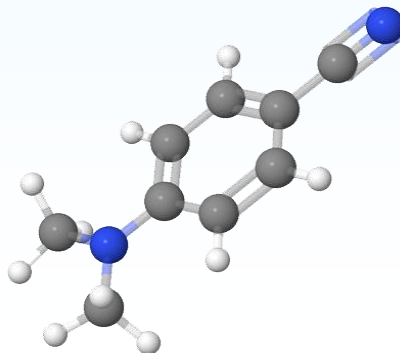
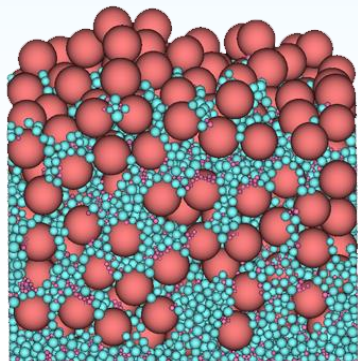
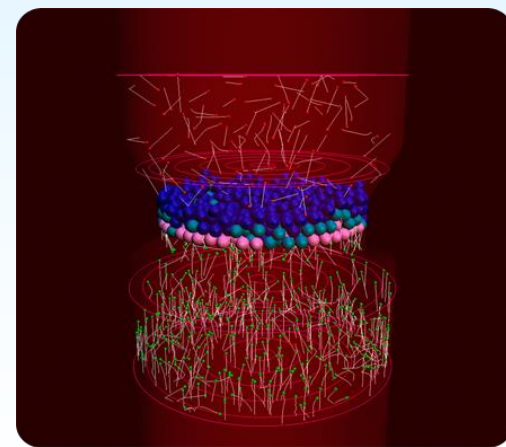
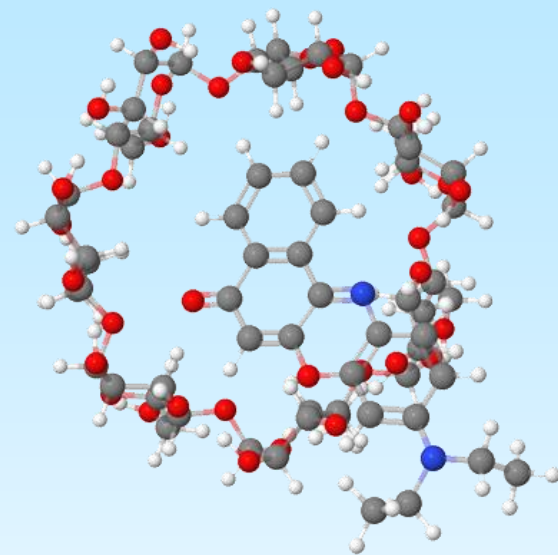
Available equipment for practical lessons:

1. Universal testing machines for tension, compression, torsion.
2. Brinell and Rockwell hardness testing devices
3. Working model a section rolling mill
4. Scanning zond microscope
5. Chamber furnace
6. Drawing mill
7. Rolling mill

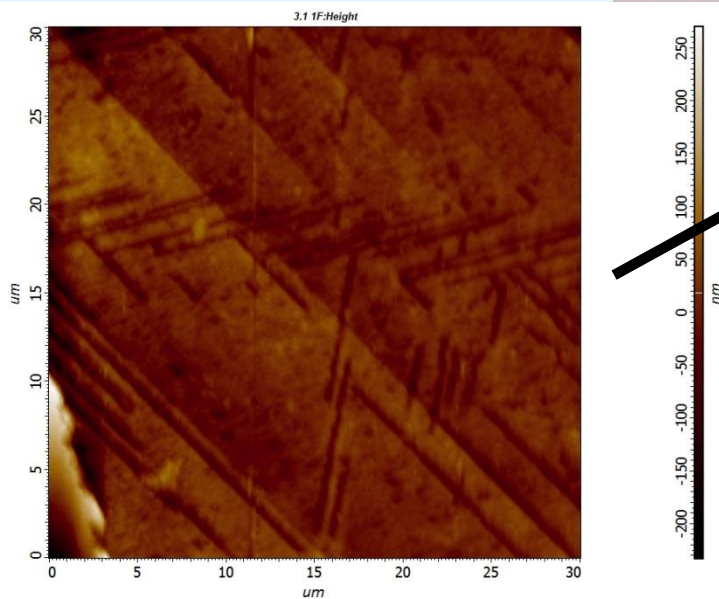
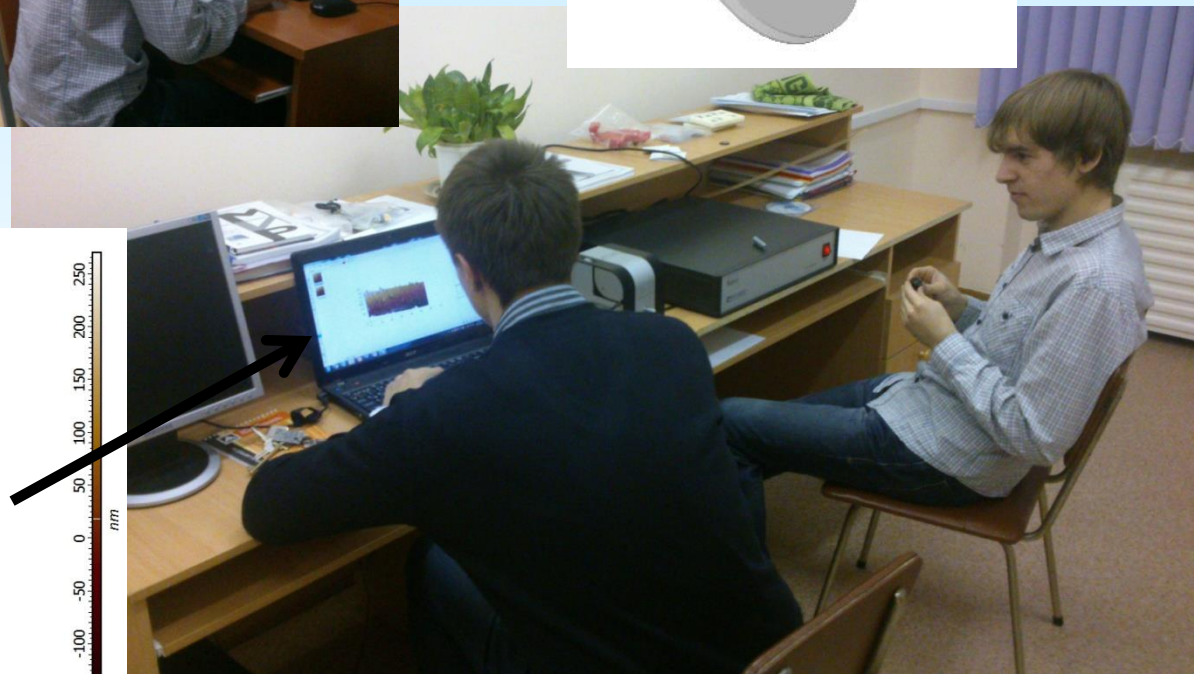
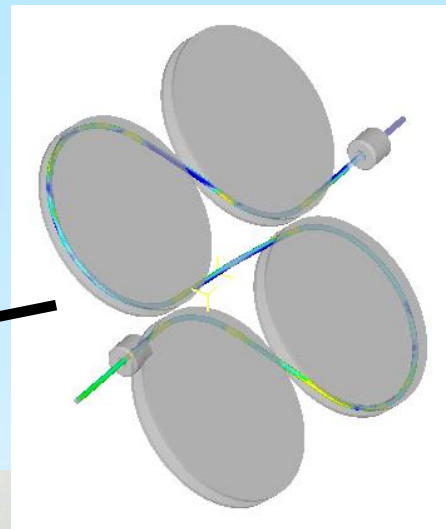
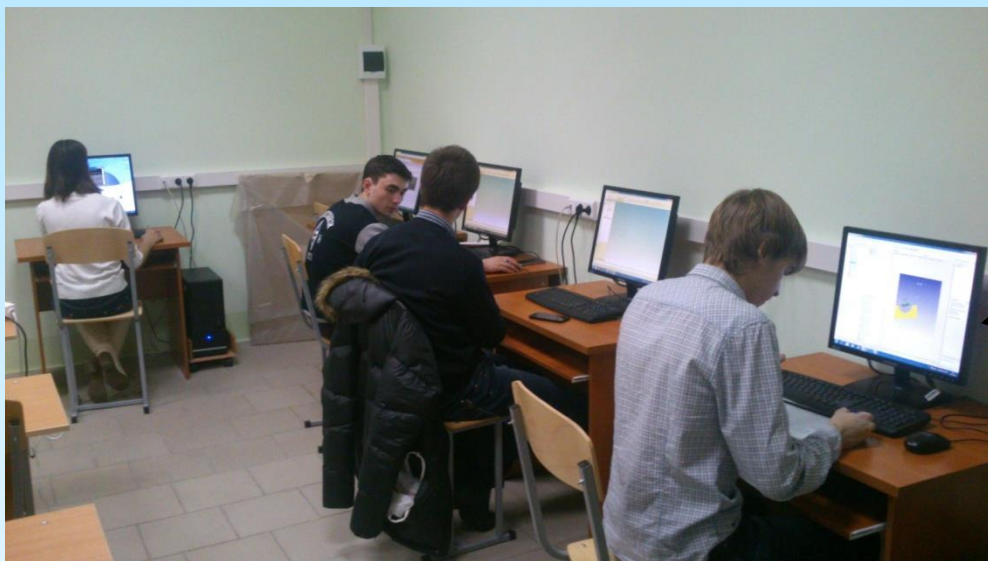


Laboratory of computer simulations

1. Simulation and study of molecules properties
2. General Atomic and Molecular Electronic Structure System (Hartree-Fock method, density functional theory, valence bond theory and etc.)
3. Design and study of supramolecules properties
4. Simulation and study of the properties of nanoparticles
5. Modeling of microstructure by close packing of spheres
6. Modeling of sintering processes
7. Modeling of nanoparticle self-organization
8. Simulation of diffusion processes in the membranes
9. Modeling of pore space permeability



Laboratory of computer simulations



Scanning zond microscopy

Laboratory equipment

Plan for the purchase of equipment :

1. H600 AM Metallurgical Microscope with Image analysis software
2. 3D Printer Picaso Designer
3. 3D Scanner RangeVision Smart
4. Anti-vibration table for SZM



Thank you for your attention!