

The Ministry of Education and Science of the Republic of Kazakhstan

Karaganda State Technical University

"Approved"
Chairman of the Scientific Council,
Rector, academician of NAS RK
A.M. Gazaliev

" ____ " _____ 2015_y.

Training programs on discipline for undergraduates
(SYLLABUS)

Discipline OMSN 5306 "The main methods for the synthesis of
nanomaterials"

TPN unit 03 "Technology nanomaterials"

Master's profile for specialty
6M070900 - "Metallurgy"

The educational program "Nanotechnologies in industry"

Faculty of Mechanical Engineering

Chair - "Nanotechnology and Metallurgy"

Foreword

Syllabus is designed:

PhD, associate professor of V.A. Andreyaschenko

Discussed at a meeting of the department "NTM"

Protocol number of _____ "_____" _____ 2015

Head. Chair of _____ V.Y. Kulikov "_____" _____ 2015
(signature)

Approved methodical bureau of engineering faculty

Minutes № _____ from "_____" _____ 2015.

Chairman _____ T.M. Buzauova "_____" _____ 2015.
(signature)

The complexity of the discipline

Semester	Amount of credits	ECTS	Type of occupation					Number of hours IWS	The amount of hours	form of control
			the number of contact hours			Number of hours IWST	Total hours			
			Lectures	Practical lessons	Laboratory lessons					
1	2	3	15	15	-	thirty	60	thirty	90	Course work

The purpose of discipline

The purpose of discipline "General methods for the synthesis of nanomaterials" is to prepare a student for research, production and technology, design and pedagogical activity in the synthesis of nanomaterials.

Problems of the discipline

Discipline objectives are: to give undergraduates knowledge of the methods of synthesis of highly dispersed nanoparticles of metals, alloys, compounds;

- The ability to give undergraduates to study the dimensional characteristics, evaluation of physical and mechanical characteristics of nanomaterials;

- Give undergraduates presentation on methods of mechanical, physical and chemical synthesis of nanomaterials;

- Practical skills to undergraduates at the choice of the method of synthesis and its use in industry.

As a result of studying the discipline masters should:

have an idea:

- The methods of mechanical, physical and chemical synthesis of nanomaterials;

- On how to study the characteristics of size,

- o principles choice of the synthesis method depending on the specific application of the nanomaterial;

know:

- Methods for producing nanoscale materials;

- Mechanisms for the formation of nanoscale materials;

- Particular properties of nanoscale materials

be able to:

- Choose the method of synthesis of nanomaterials;

- Examine the dimensional characteristics of nanomaterials;

- Choose the equipment for the synthesis of nanomaterials.

Prerequisites

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Postrekvizity

Module Technology nanopowders.

Thematic plan of discipline

Name of section (themes)	The complexity of occupations, hours.				
	lectures	practical	laboratory	IWST	IWS
1. 1. Introductory lecture. The objectives and content of the course. Common understanding of the methods of synthesis of nanomaterials	1	1	-	2	2
2. Classification of methods for the	2	2	-	2	2

synthesis of nanomaterials 2.1. The main methods for the synthesis of nanomaterials "bottom - up". 2.2 Basic methods for the synthesis of nanomaterials on a "top - down"					
3. Physical methods for the synthesis of nanomaterials 3.1. MBE. 3.2 Method evaporation followed by controlled growth in an inert atmosphere, and stabilized nanoparticles. 3.3 Methods of lithography.	2	2	-	8	8
4. Chemical methods for the synthesis of nanomaterials. 4.1 The sol-gel synthesis method. 4.2 Synthesis in micelles. 4.3 Chemical precipitation. 4.4 The removal of one of the components of a heterogeneous system.	2	2	-	8	8
5. Mechanochemical synthesis of nanomaterials.	2	2	-	2	2
6. The gas-phase synthesis of nanomaterials.	2	2	-	2	2
7. Mechanochemical detonation synthesis and electric explosion.	2	2		4	4
8. The formation and growth of nanoparticles.	2	2		2	2
TOTAL:	15	15	-	thirty	thirty

The criteria for assessment of knowledge of undergraduates

The final grade is determined by the assessment of the discipline of the course work and the protection of the value of up to 100% in accordance with the table.

Based on letter system	The digital equivalent of letter grade	The percentage of learned knowledge	Based on Traditional system
A A-	4.0 3.67	95-100 90-94	Excellent
B + AT AT-	3.33 thirty 2.67	85-89 80-84 75-79	Good
C + FROM FROM- D + D	2.33 20 1.67 1.33 10	70-74 65-69 60-64 55-59 50-54	Satisfactorily

Lecture notes	0.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3
IWST	2	*	*		*	*			*	*		*	*			*	20
IWS	5					*					*					*	15
Landmark control	10							*							*		20
Total (for certification)								thirty							thirty		60
Exam	40																40
In total																	100

Policies and Procedures

In the study of discipline "Preparation of ores for smelting" I beg to observe the following rules:

1. Do not be late for class.
2. Do not miss classes without good reason, in case of illness please submit a certificate, in other cases - an explanatory note.
3. The duties of a student includes access to all kinds of activities.
4. According to the calendar schedule of the educational process to take all kinds of control.
5. Missed practical and laboratory classes to fulfill the specified time teacher.
6. In case of default setting, the final assessment is reduced.
7. Actively participate in the learning process, to support the constructive feedback on all sessions.
8. Be polite and friendly to fellow students and teachers.

Thematic plan of independent work of a student with a teacher

Name of the theme IWST	The purpose of employment	Form of	The content of the job	Recommended reading
1	2	3	4	5
Theme 1. The function of materials derived technique of "bottom - up" and "top - down".	Increased knowledge on the subject	Conference	The study of the classification of nanomaterials and destination obtained by the methods of synthesis	[1 -6]
Theme 2. Physical methods of synthesis of nanomaterials.	Increased knowledge on the subject	Seminar	The study of nanomaterial prepared by molecular beam epitaxy, nanolithography. Principle stabilize the nanoparticles obtained by evaporation followed by controlled growth in an inert atmosphere.	[1- 6]
Theme 3. Methods for the synthesis of nanomaterials in the	Increased knowledge on the subject	Seminar	X Learning basic methods of synthesis in the	[1- 4], [6]

micelles.			micelles and control the properties of nanomaterials.	
Theme 4. The mechanisms and kinetics of the gas-phase method for the synthesis of nanomaterials	Increased knowledge on the subject	Paperwork	The study of the mechanisms and kinetics of the gas-phase method for the synthesis of nanomaterials	[1-11]
Subject 5. The structure of the materials obtained by the methods of the explosion.	Increased knowledge on the subject	Presentation	Truktury studymaterials obtained by the methods of the explosion, a comparative analysis of nanomaterials obtained by mechanochemical, detonation synthesis and an Electric	[1 13]
Topic 6 The formation and growth of nanoparticles	Increased knowledge on the subject	Presentation	Characteristics of the formation and growth of nanoparticles. Study of the effect on the degree of supercooling properties of the material teaches.	[1 -13]

Threads of control tasks for IWS

- 1 Individual job of choosing a method of synthesis for a particular nanomaterial.
- 2 individual tasks to study the characteristics of nanomaterials depending on the method of synthesis.

Timetable for implementation and delivery tasks for the discipline

Type of control	The purpose and content of the job	Recommended literature	Durations of the performance	form of control	Deadline
Interrogatories number 1	Securing the theoretical knowledge and practical skills	[1] [2] [3] [5] lecture notes	1 contact hour	Landmark	7- Week
Report IWS (theme 1)	Control of theoretical knowledge.	[1], [2], [4], [5], [7]	7 weeks	Current	7 th week
Interrogatories number 2	Securing the theoretical knowledge and practical skills	[1], [2], [6] lecture notes	1 contact hour	Landmark	14 th week
Report IWS (theme 2)	Control of theoretical knowledge	[1], [2], [4], [5], [7]	7 weeks	Current	14 th week

Exam	Checking the assimilation of the material discipline	The entire list of basic and additional literature	2 contact hours	Outcome	During the session,
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Key references

1. Форстер. Нанотехнология, наука, инновации, возможности. –М.: Техносфера, 2008. - 352с.
2. Валиев Р.З., Александров И.В. Объемные наноструктурные металлические материалы, получение структуры и свойства. –М.: Академия, 2007, -398с.
3. Гусев А.И., Ремпель А.А. Нанокристаллические материалы – М.: ФИЗМАТЛИТ, 2010. – 224 с.
4. Явойский А.М. Нанотехнологии и наноматериалы – М., Наука, 2008 г., 365 с.
5. Р.А. Андриевский, А.В. Рагуля. Наноструктурные материалы. Учеб. пособие для высш. учеб. заведений. — М.: Издательский центр «Академия», 2005.
6. Перспективные материалы/ под ред.проф. Д.Л.Мерсона. Уч.пособие. –М.:ТГУ, 2007. - 468с.
7. Кормилицын О.П., Шукейло Ю.А. Механика материалов и структур нано и микротехники. - М.: Академия, 2008, -224с.
8. Добаткин С.В. Лакишев Н.П. Перспективы получения и использования наноструктурный сталей//Всероссийская конференция по наноматериалов НАНО. 2007. – Тезисы докладов. –Новосибирск, 2007.
9. Добаткин С.В. Наноматериалы. Объемные металлические нано и субмикрокристаллические материалы полученные интенсивной пластической деформацией. Уч.пособие/ Добаткин С.В. –М.:МИСиС, 2007. -36с.
10. Рыжонков Д.И. и др. Ультрадисперсные среды. Получение нанопорошков методом химического диспергирования и их св-ва. Учебное пособие/ Рыжонков Д.И., Левина В.В., Дзидзигури Е.Е. –М.: Изд-во МиСиС, 2006. -135с.
11. Кормилицын О.П., Шукейло Ю.А. Механика материалов и структур нано и микротехники. -М.: Академия, 2008, -224с.
12. Adéla Macháčková, Violetta Andreyachshenko, Zuzana Klečková Modeling of forming technologies based on SPD processes, LAP LAMBERT Academic Publishing, 2015-07-13, P. 124.

Additional reading

13. Рыжонков Д.И. и др. Ультрадисперсные среды. Получение нанопорошков методом химического диспергирования и их св-ва. Учебное пособие/ Рыжонков Д.И., Левина В.В., Дзидзигури Е.Е. –М.: Изд-во МиСиС, 2006. -135с.
14. Соронин Г.М. Трибология сталей и сплавов. –М.: Недра, 2000. -316с.

Example topics of coursework:

1. Ultra-nanomaterials based on titanium.
2. The relevance of the production of nano or ultrafine materials.
3. Physical methods for nanomaterials?
4. The method of controlled crystallisation of amorphous materials?
5. Ultra-vanadium-based nanomaterials?
6. The essence of the method of molecular-beam epitaxy?
7. Application of physical methods for the synthesis of nanomaterials?
8. Synthesis nanoamorfnyh metallic material (nanostěkl)?
9. Synthesis alumina based nanomaterials?
10. . Properties synthesis of nanoparticles based on vanadium?

List of Questions:

1. What are the main methods of obtaining nanopowders of chemical?
2. What are the features and benefits of a mechanical method of obtaining nanostructures?
3. What chemical methods for fabricating nanostructures?
4. What are some ways you can get the nanoparticles of precious metals?
5. Which substances can be used as reducing agents in the preparation of the nanoparticles of gold and silver?
6. Why is the excess surface energy of nanoparticles?
7. Why is enhanced germicidal silver nanoparticles?
8. By what mechanism there is a restoration of silver nanoparticles using citrate ions?
9. Give examples of biological method of producing nano?
10. What are the methods of consolidation of nanopowders?
11. What is the unique properties of nano?
12. What is the stabilization of nanoparticles? What is it for? Whereby the process of stabilization of nanoparticles?
14. What is the phenomenon called surface plasmon resonance?
12. Write the reaction of aluminum oxide formation during anodic oxidation.
13. Give examples of nanopowders ferrous and nonferrous metals (optional)?
14. What is the advantage of a combination of methods of physical and chemical transformations?
15. What is the encapsulation of nanoparticles?