TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

Director of the School of Advanced Manufacturing Technologies _____ Alexey N. Yakovlev

CourseName

Nanostructured metal and ceramic based materials: technologies, structures and properties

Field of Study: Major 22.04.01 Material Science and Technologies

Programme name: Material Science

Level of Study: Master Degree Programme

Year of admission: 2019

Semester, year: 2, 2020

ECTS: 6
Total Hours: 216
Contact Hours: 80

- **Lectures:** 16
- **Labs:** 24
- **Practical experience:** 40

Assessment: exam

Division for Materials Science

Head of Division for Materials Science _____ Vasiliy A. Klimenov

Instructor(s) _____ Segey V. Matrenin

Course Name

Course Overview

Course Objectives	The subject is focused on training of specialists in the field of research and development of novel structural and functional materials. The students will obtain knowledge and skills in the field of computer simulation of materials and technological processes.
Learning Outcomes	Professional competency includes knowing of issues on the research and development of novel materials and structures, in particular: - materials for structural and functional applications for different industries, including electronics and medicine, and technology of surface hardening and coating; - principles for design of novel materials – nanostructured, smart, gradient and composite materials with ceramic, metal and polymer matrix; - technologic facilities and devices for surface hardening and coating deposition; - manufacturing processes for advanced materials; - methods for investigation of properties and diagnostics of loaded materials and structures; - physical and chemical models of materials and manufacturing processes; - law and regulatory issues of application of new materials.
Course Outline	The course involves lectures, practical classes and laboratory works. Nanostructured materials (NsM) are solids composed of structural elements - mostly crystallites - with a characteristic size (in at least one direction) of a few nanometers. In course NsM will classified into groups according to the shape and chemical composition of their constituent structural elements. The atomic structure and properties of NsM and its deviate from the ones of a single crystal and/or glass with the same chemical composition will describe. Dimensionality effects due to the shape of the crystallites (thin plates, needles or equiaxed shape), and the reduced density and/or modified coordination numbers will discuss. Some of the experimental observations supporting these ideas are discussed. Technological applications of ceramic, metallic and composite NsM will described.
Prerequisites (if available)	Theory of materials structure; Physical and mechanical properties of materials; Modelling and optimization of materials properties and technological processes
Course Structure	• Determination of nanomaterials • Methods of obtaining nano-particles • Physical and chemical approaches • Methods of bulk nano-materials obtaining • Fin-films • Peculiarities of structure and properties nano-materials • Methods of studies of nano-materials • Oxides nano-systems
Facilities and Equipment	Optical microscopes, Hardness testers, X-ray diffractometer, Transmission electron microscope, Scanning electron microscope, Nano indenter Nanotest G200, Universal electromechanic Inston, hydraulic BiSS UTM 150 testing machines, technology equipments.
Grading Policy	In accordance with TPU rating system we use: - Current assessment which is performed on a regular basis during the semester by scoring the quality of mastering of theoretical material and the results of

	practical activities (performance tests, perform tasks, problem solving). Max score for current assessment is 60 points, min – 40 points. - Course final assessment (exam/ credit test) is performed at the end of the semester. Max score for course final assessment is 40 points, min – 22 points. The final rating is determined by summing the points of the current assessment during the semester and exam (credit test) scores at the end of the semester. Maximum overall rating corresponds to 100 points, min pass score is 80.
Course Policy	Class attendance will be taken into consideration when evaluating students' participation in the course.Students are expected to actively engage in class discussions about the assigned readings. Attendance is strictly controlled. All classes is obligatory to presence.
Teaching Aids and Resources	Compulsory Readings: 1. Матренин С.В. Наноструктурные материалы в машиностроении: учебное пособие [Электронный ресурс] / С. В. Матренин, Б. Б. Овечкин. — Томск: Изд-во ТПУ, 2010. Схема доступа: http://www.lib.tpu.ru/fulltext2/m/2011/m33.pdf 2. Андриевский Р.А. Основы наноструктурного материаловедения. Возможности и проблемы. - Издательство "Лаборатория знаний" (ранее "БИНОМ. Лаборатория знаний"), 2017. Схема доступа: https://e.lanbook.com/book/94128?category=3827 3. Колмаков А.Г., Баринов С.М., Алымов М.И. Основа технологий и применение наноматериалов. - Издательство "Физматлит", 2012. Схема доступа: https://e.lanbook.com/book/59644 Extra Readings: 1. Гусев А.И. Наноматериалы, наноструктуры, нанотехнологии. - Издательство "Физматлит", 2009. Схема доступа: https://e.lanbook.com/book/2173 2. Волочко, А. Т.. Огнеупорные и тугоплавкие керамические материалы [Электронный ресурс] / Волочко А. Т., Подболотов К. Б., Дятлова Е. М.. — Минск: Белорусская наука, 2013. — 385 с.. — Книга из коллекции Белорусская наука - Инженерно-технические науки.. — ISBN 978-985-08-1640-5. Схема доступа: https://e.lanbook.com/book/90503 3. Штремель М.А. Материаловедение: неметаллические и композиционные материалы: курс лекций [Электронный ресурс]. - Москва: МИСИС, 2013. - 77 с. Схема доступа: https://e.lanbook.com/book/117282
Instructor(-s)	Sergey V.. Matrenin, msv@tpu.ru