НОЦ "НАНОТЕХНОЛОГИИ" РУДН: НАУЧНЫЕ И ОБРАЗОВАТЕЛЬНЫЕ ПРОЕКТЫ МЕЖДУНАРОДНОГО УРОВНЯ

NANOTECHNOLOGY CENTER AT PFUR: SCIENTIFIC AND EDUCATIONAL PROJECTS OF INTERNATIONAL LEVEL

Ярослав Михайлович, каковы структура, специализация и задачи НОЦ "Нанотехнологии"?

В структуру центра входят три лаборатории: нанофармтехнологий, нанотрибологии и морфологии поверхности, а также плазменных исследований наноструктур и наноструктурирования металлов.

Материально-техническая база и высокая квалификация персонала, включающего докторов и кандидатов наук, позволяют выполнять исследования и разработки в сфере нанотехнологий и наноматериалов для биотехнологии, медицины, фармацевтики, микро- и наноэлектроники, фотоники,

5 февраля Российскому университету дружбы народов исполнилось 55 лет. РУДН – один из наиболее известных на международной арене отечественных образовательных и научных центров, который неизменно занимает высокие места в мировых рейтингах вузов. Университет готовит специалистов для различных областей знаний – от гуманитарных и социально-экономических наук до инженерно-технических и медицинских направлений. РУДН активно участвует в научно-исследовательских и опытно-конструкторских работах по приоритетным научным направлениям, включая нанотехнологии. В 2007 году в рамках Федеральной целевой программы "Развитие инфраструктуры наноиндустрии в Российской Федерации на 2008–2011 годы" в университете был создан научно-образовательный центр по направлению "Нанотехнологии" (НОЦ "Нанотехнологии"). О работе центра рассказал его директор Ярослав Михайлович Станишевский.

The 5th of February marked the 55th anniversary of the Peoples' Friendship University of Russia (PFUR). The PFUR is one of the world's most prominent educational and scientific centers in Russia, which always ranks as one of the top universities of the world. The University trains specialists in different fields of expertise, from humanitarian and socioeconomic sciences to engineering technical and medical fields. The PFUR is actively involved in scientific research and design activities related to top priority scientific domains, including nanotechnologies. In 2007, under the Federal target program "Development of the infrastructure of nanoindustry in the Russian Federation for 2008-2010" the University created the Scientific Educational Center for Nanotechnologies (Nanotechnologies SEC). Yaroslav Stanishevsky, the Director of the Center, told us about its activities.

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Interview with Director of the Nanotechnologies SEC at the Peoples' Friendship University of Russia, D.Sc. Ya.Stanishevsky

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Mr. Stanishevsky, what are the structure, specialization and objectives of the Nanotechnologies SEC? 

The Center comprises three laboratories: a pharmaceutical nanotechnology laboratory, a nanotribology and surface morphology laboratory, and metal nanostructure plasmatic research and nanostructuring laboratory. The infrastructure and highly skilled personnel, including doctors and masters of sciences enable the Center to conduct research and design in the field of nanotechnologies and nanomaterials for biotechnology, medicine, pharmaceuticals, microelectronics and nanoelectronics, photonics, material engineering. Our nanotechnology priorities are biomedical and pharmaceutical fields. These are the domains where we implement most of our educational and scientific research projects. The main objectives of the Center are to conduct research and design in the field of nanotechnologies and to train or retrain scientific and working staff members of biomedical, pharmaceutical and nanotechnology enterprises.

What equipment does the Center have? 

We have a set of instruments for a comprehensive study of nanoscale items and structures. In particular, the JEOL JEM-2100 transmission electronic microscope is used for exploring the atomic structure, morphology and chemical composition of a wide range of materials; the NanoScan-3D scanning nano-hardness tester is used for exploring the surface topology and structure of materials using the nanoindentation method; the NTEGRA Spectra complex is used for investigating surfaces by means of scanning probe microscopy and Raman spectroscopy; the Nanophox apparatus is used to determine the size of particles and their size distribution; the Nano Spray Dryer B-90 offers the possibility to convert liquid mixtures into dry nanopowder; the Nikon IM-Q biostation is used to study the kinetics of cell growth. In addition, we have tools to determine the thermal stability of substances and materials (NETZSCH Jupiter F1 with a quadrupole mass analyser), to carry out chromatographic analysis of complex mixtures of organic substances and gases (Crystal 5000...
with ion trap and other detectors), to determine the polarization of the physical properties of the crystalline and semiconductor nanostructures and to conduct other research activities.

Please, tell us about educational programs of the Center.

In 2014, our Center began training Masters in the educational program of Innovative technologies and nanotechnologies in medicine, pharmaceuticals and biotechnology. The Ministry of education and science of the Russian Federation provided five publicly funded places for the first enrolment, and we formed a group of 11 people. The goal of the four-semester program is to train highly qualified professionals with skills in the field of applied biomedical, and pharmaceutical nanotechnologies to work in the largest public and private biomedical and pharmaceutical enterprises of the country and in the world’s nanotechnology centers.

In recent years, the biomedical and pharmaceutical industries have been growing rapidly, but specialists are scarce because domestic medical universities mostly train medics and pharmacists, whilst enterprises mostly need technologists. Consequently, for the next academic year, the Ministry of education and science has increased the number of publicly funded places for the Master’s program up to twelve. We are trying hard to make the learning process as close to the practice as possible, therefore in our classes we actively cooperate with leading companies of the sector, so the students become acquainted with the modern nanotechnology used in the production.

Besides, the Nanotechnologies SEC takes part in the preparation of the master degree program for Engineering and physics
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<th>Competent Opinion</th>
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<tr>
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<td>• The teaching staff of the University consists of about 2,300 people, including more than 500 professors and doctors of sciences, more than 1,200 associate professors and candidates of sciences.</td>
<td>• According to the QS World University Rankings, PFUR is in the TOP 500 best universities in the world.</td>
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<td>• According to the Russian science citation index, by the number of scientific articles PFUR occupies the 6th place among scientific and educational institutions of Russia and the 4th place among Russian universities.</td>
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<td>• PFUR is the leader among Russian universities both in the number of master’s programs in English (more than 30), and in the number of joint master’s programs (more than 100) with the leading universities of the world.</td>
<td>• According to the Interfax rating, PFUR in 2011–2014 annually takes 4th – 6th place among Russian universities.</td>
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<td>• PFUR is a member of the International Association of universities, the Eurasian Association of universities, European University Association, European Association for international education.</td>
<td>• According to the Tomson Reuter for May 2014, PFUR takes the second place in Russia by the number of national patents for inventions for 2002–2012.</td>
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Technologies in nanotechnology, which is implemented by the Engineering department of the PFUR jointly with the Kurchatov Institute, and the bachelor degree program for Nanoengineering. The students, who study these fields, come to our Center to do practice, to write theses.

The Nanotechnologies SEC developed seven advanced vocational training courses (specialist courses and short-term career enhancement courses). The training course of "Science-Intensive technologies and nanotechnologies in medicine, pharmaceuticals and biotechnology" is designed for two semesters with the disciplines and approach to organizing the educational process close to the Master’s program. The course is administered as an on-the-job training and is designed primarily for employees of pharmaceutical and biomedical companies.

The short-term training programs comprise from 36 to 72 or more academic hours. They are arranged in full-time and part-time forms. We have developed six programs on various aspects of nanotechnology and biotechnology, intellectual property management, as well as the theory and practice of transmission electron microscopy. I would like to make a special mention of the program devoted to "Organizational principles for technological and nanotechnological production in medicine and pharmaceutics", which is included in the educational project of "Russian Pharmaceutical Personnel Pool" launched in 2013 by the group of companies Pharmcontract. In general, it can be noted that all programs are geared towards obtaining practical knowledge according to the needs of the students.

The Nanotechnologies SEC is also engaged in the training of higher qualification professionals – graduate and doctoral students.
Currently, two graduate students are studying in the graduate center in the fields of chemical science and biological science.

Given the high speed of innovative technology development and practical orientation of training programs, how do you resolve the problem with the teaching staff?

Six of the twelve members of the Center are teachers (professors and associate professors), but we understand that the real knowledge of production issues requires practice. Therefore, in the sessions we involve highly qualified professionals with experience in pharmaceutical and biomedical companies. Furthermore, some courses are delivered by faculty of other universities and research institutes.

What scientific projects are implemented by the Center?

Research is conducted in the fields of biomedical and pharmaceutical nanotechnologies, nano-systems for membrane-catalytic and catalytic processes, nanotribology and surface morphology, nano-optoelectronics, spintronics and computing nanotechnologies, as well as the plasma techniques used for exploring nanostructures.

In the field of medicine and pharmaceutics, we are developing systems for selective intracellular delivery of antiviral and anti-cancer drugs based on nanoparticles of inorganic selenium, silver, gold, and carbon nanotubes and liposomal nano-complexes. Currently, we are investigating the methods of obtaining nano-carriers and the techniques for transporting drugs using them. In particular, the research on the production of nanoparticles for carrying drugs is held in conjunction with the specialists of State Research Institute of Genetics and Selection of Industrial Microorganisms, who

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<tr>
<td>Лазерный интерферционный микроскоп</td>
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<td>Сканирующий нанотвердомер</td>
<td>НаноСкан-3D (ТИСНУМ)</td>
<td>Исследование рельефа и структуры поверхностей, измерение механических свойств методами наноиндентирования и склерометрии</td>
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<td>Профилометр</td>
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<td>Измерение шероховатости поверхности, высоты неровностей, планарности и прогиба пластин</td>
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<td>Атомно-силовой микроскоп</td>
<td>ИНТЕГРА Спектра (НТ-МДТ)</td>
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<td>Биостанция с инвертированным микроскопом, инкубатором и CCД-камерой</td>
<td>IM-Q (Nikon)</td>
<td>Исследование кинетики роста клеток</td>
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<td>Сканирующий спектрофотометр</td>
<td>Lambda 950 (Perkin Elmer)</td>
<td>Качественный и количественный анализ химических веществ, анализ оптических образцов на пропускание и отражение</td>
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**Лаборатория нанотрибологии и морфологии поверхности**

**Nanotribology and surface morphology laboratory**

**Лаборатория нанофармтехнологий**

**Pharmaceutical nanotechnologies laboratory**
use biological synthesis methods, while we use chemical methods.

Another major field of research is the development of diagnostic test systems, for example, polymeric nano- and microspherical particles carrying specific bioligands for detection of antigens, antibodies, macromolecular markers in infectious and autoimmune diseases of humans and animals. The Center collaborates with Mechnikov Research Institute of vaccines and sera and Lomonosov Moscow State University of fine chemical technologies in developing test systems for the diagnosis of autoantibodies to thyroglobulin in the thyroid gland and has produced the first samples of the drug.

How close are these inventions to the introduction into medical practice?

For the time being, it is not an issue of the near future because the knowledge of various aspects of the nanoparticles safety is not enough yet. Therefore, the Russian pharmaceutical companies are still very cautious about scientific developments in the field of nano-drugs.

Does the Center collaborate with nanotechnology communities?

We believe exchange of information and experience to be very important, so we try to participate actively in the professional community. In particular, we cooperate with the Fund for infrastructure and educational programs of Rusnano; we participate in the Russian National Nanotechnology Network; we are members of the International Association NanoBRIDGE, which develops Russian and German cooperation in the field of biomedical nanotechnology.

Does the active presence of the PFUR in the international market...
of educational services impose special requirements on the work of the Center? The PFUR is under a thorough scrutiny of experts from international rating agencies. Therefore, all the University departments, including our Center are obliged to meet the highest requirements. The international ranking of QS University Rankings places the PFUR among the TOP-500 universities of the world and among TOP-100 universities of the BRICS countries; in the global ranking of Webometrics, the University occupies the 20th position among the universities of Russia; in the Annual National Rating of Russian Universities, it occupies the 5th position; in the Interfax ranking, it occupies the 7th position among the universities of the CIS countries, Baltic States and Georgia.

What are the development plans of the Center? In the future, we would like to develop our program for Masters. In particular, we would like to offer the course in English. In addition, we have plans to create a Bachelor degree with in-depth study of nanotechnology. As for the scientific work, we plan to continue researches in the field of nanotechnologies and nanomaterials for the biomedical and pharmaceutical industries.

The interview was taken by Dmitry Gudilin and Olesya Lavrenteva
осторожно относятся к научным разработкам в области нанолекарств.

Сотрудничает ли центр с нанотехнологическими сообществами?
Мы считаем очень важным обмен информацией и опытом, поэтому стараемся активно участвовать в работе профессиональных сообществ. В частности, сотрудничаем с ФЦП "Роснано", участвуем в Российской национальной нанотехнологической сети, являемся членами международной ассоциации NanoBRIDGE, которая развивает российско-германское сотрудничество в сфере биомедицинских нанотехнологий.

Активная работа РУДН на международном рынке образовательных услуг обуславливает особые требования к работе центра?
РУДН находится под пристальным вниманием экспертов международных рейтинговых агентств, поэтому все подразделения университета, в том числе наш центр, должны соответствовать самым высоким требованиям. В международном рейтинге QS University Rankings РУДН входит в ТОП-500 лучших университетов мира и ТОП-100 университетов стран БРИКС, в глобальном рейтинге Webometrics занимает 20-е место среди университетов России, в ежегодном Национальном рейтинге российских вузов – 5-е место, в рейтинге "Интерфакс" – 7-е место среди вузов стран СНГ, Балтии и Грузии.

В первую группу студентов, обучающихся по программе "Инновационные технологии и нанотехнологии в медицине, фармацевтике и биотехнологии", входят два иностранных студента, вообще же в РУДН иностранных студентов более 50%.

Каковы планы развития центра?
В будущем мы хотели бы развивать нашу программу для магистров, в частности, предложить курс на английском языке. Кроме того, есть планы создания бакалавриата с углубленным изучением нанотехнологий. Что касается научной работы, то мы планируем продолжать вести исследования в области нанотехнологий и наноматериалов для биомедицинской и фармацевтической отрасли.

Спасибо за интересный рассказ.
С Я.Станишевским беседовали Д.Гудилин и О.Лаврентьева