Made by Polytech: Prime Minister of the Russian Federation Dmitry Medvedev Became Acquainted with Advanced Research and Development Carried out at the University

The visit of the Chairman of the Government of the Russian Federation presented Peter the Great St. Petersburg Polytechnic University scientists with a unique opportunity to acquaint the highest–level leader of the country with recent research developments as well as bring forth and secure faster innovation advancement.

Before joining the meeting of the Presidium of the Council for Economic Modernization and Innovative Development under the President of the Russian Federation, Prime Minister DMITRY A. MEDVEDEV paid a visit to the Research Laboratory of Lightweight Materials and Structures, where the results of research efforts accomplished at the University were exhibited. The exhibits also attracted the attention of guests and Council members – Deputy Prime Minister ARKADY V. DVORKOVICH, Minister of Healthcare VERONIKA I. SKVORTSOVA, Presidential Envoy to the Northwestern Federal District VIKTOR I. BULAVIN, Deputy Minister of Education and Science ALEXANDER B. POVALKO, St. Petersburg Governor GEORGY S. POLTAVCHENKO and others.

The Chairman of the Russian Government paid close attention to the explanation of research and innovation projects of the Polytechnic University given to him by SPbPU Rector Andrey I. Rudskoy and the representatives of University laboratories and other scientific units. During the excursion, D.A. Medvedev became acquainted with various projects in laser welding, medicine, digital technology, etc. Some of the innovations have found industrial applications and are now utilized in the car and aircraft industry, shipbuilding and rocket production.

The excursion started at a display booth of the Laboratory of Lightweight Materials and Structures that conducts research on designing lightweight structures made of light materials such as aluminum. «We are trying to cover the full cycle from producing materials to welding composite structures,» explained Anton NAUMOV, Assistant Professor at the Department of Material Science and Technology. «To weld lightweight materials, we are exploring a comparatively new solid-phase welding technique – friction stir welding». At the end of 2014, SPbPU acquired a unique five-axis friction stir welding machine within the framework of the project «National Research University». It was put into operation in 2015 and then used in experiments on friction stir welding in an SPbPU laboratory headed by Professor Veselin Mikhailov, a leading scientist working at Brandenburg University of Technology (Cottbus, Germany). At present, there is some research being done on the development of technologies for the friction stir welding of dissimilar materials, materials with non-uniform thickness, and various types of lightweight composites. Friction stir welding is a remarkable method to join different types of materials as it

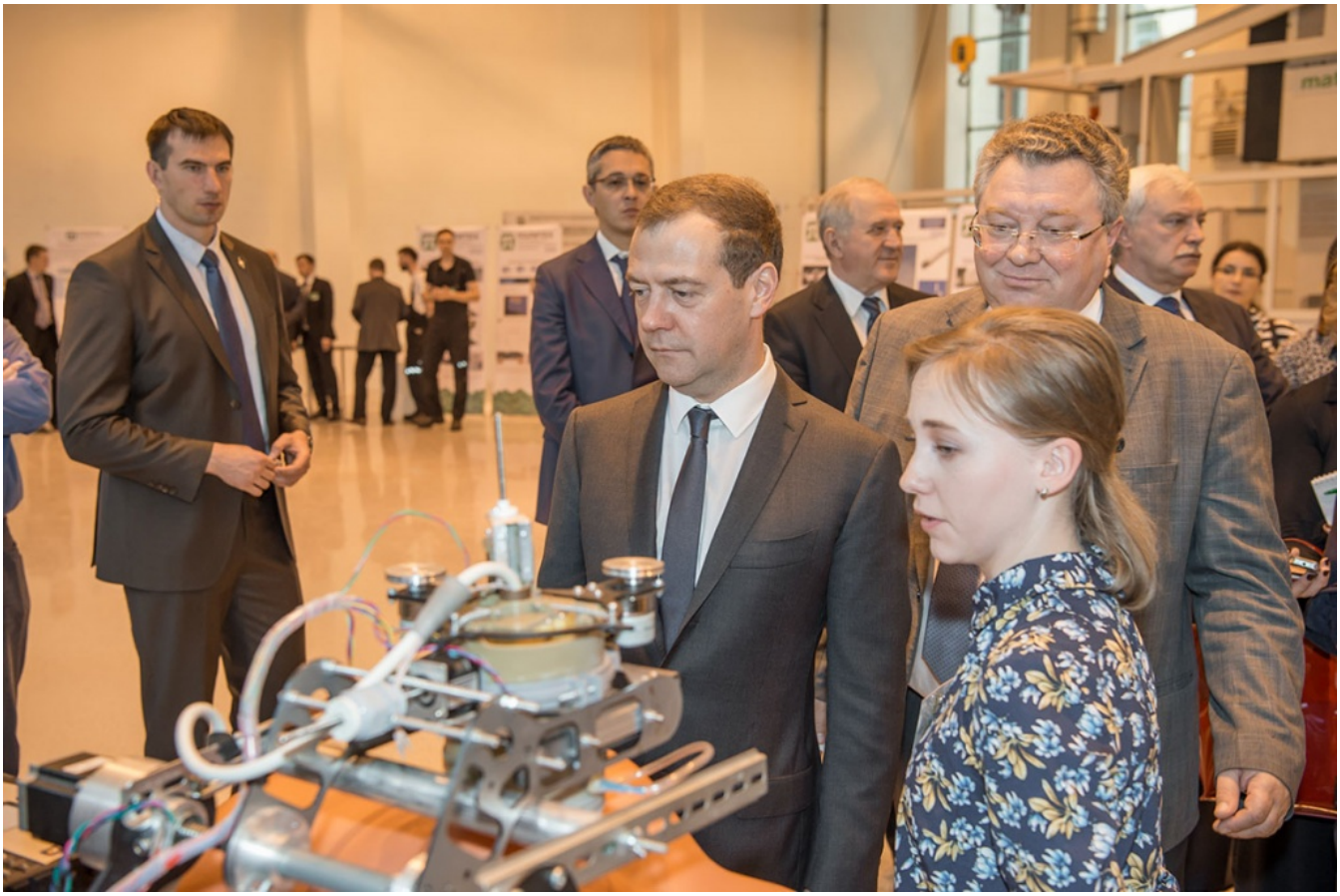
allows for reduced heat generation. «This welding method is widely used overseas for making long straight welds in shipbuilding, for joining extruded aluminum panels in railway carriage manufacturing and for welding girth seams in rocket production,» Anton Naumov added. «We make use of this machine in laboratory classes. It is also of great help to students working on their bachelors' or masters' theses. In this way, they can learn a lot about emerging and cutting edge technologies.»

Evgeny ZEMLYAKOV, Assistant Professor at the Department of Welding and Laser Technologies, talked at length about advanced laser technologies, mostly those developed at the Institute of Laser and Welding Technologies, and their employment in industry. For instance, arc augmented laser welding makes it possible to manufacture a component within a few minutes, as opposed to a few hours of manual welding. The Chairman of the Russian Government learnt about the process of «growing» components used in shipbuilding and aircraft production out of metal powder. «You can see here what Polytech has to offer in the area of advanced laser technologies for industrial applications. There are mobile and robotic systems for hybrid arc augmented laser welding and an unparalleled robotic additive manufacturing system using the technology of laser assisted direct growth, just to name a few,» the researcher elaborated. This technology is to be implemented into the manufacturing process as early as next year. Thus far, the technology has been certified by the Russian Register of Shipping and found fully ready for industrial application. Evgeny ZEMLYAKOV explained the potential of the

given technology: «The laser growth system was developed with support from the Ministry of Science of the Russian Federation and commissioned by the United Engine Corporation to manufacture large-size aircraft engine parts. Here, you can see some samples of such high-precision work parts. Pilot production using this type of equipment will have been established in “Kuznetsovo”, Samara, by the end of the year.»

At the display booth of the Laboratory of Lightweight Materials and Structures, Prime Minister learnt about another technology which can be exploited in different ways, for example, in the aircraft industry. The five-axis turning-milling machining center allows working with up-to-date technology software packages that comply with the conception of «smart production» and manufacturing workpieces of complex geometry from hard-to-machine materials, thus, totally abandoning manual handling. «We were the first to use this machinery to manufacture, by machining the blade, the VIT-1 from intermetallic alloy and the shroud from the VTI-4 alloy intended for a promising aircraft engine,» the booth attendant specified. «We now plan to work on developing an advanced digital technology to produce compressor rotors of complex geometry for Arsmach LLC. A concurrent task under the import substitution program is to create Russian machinery of comparable quality in collaboration with Baltiyskaya Promishlennaya Kompaniya.»

The Chairman of the Russian Government was told about a project of scientists at the Department of Turbines, Hydro Machines and Aircraft Engines of the Institute of Energy and Transport Systems, SPbPU, who suggested new ways of harnessing the energy stored in compressed natural gas at gas distribution stations (GDS). Department staff have been engaged in the project since 2007, and it eventually resulted in the creation of «MDG-20», a 20 kW micro-turbo-expander. It was explained that «the expander makes use of a low-emission axial-flow turbine, petal-shaped gasodynamic bearings, a high-speed generator, and an electronic power converter. Gas pressure differences cause the low-emission turbine to rotate and the generator to produce electric power. This turbine provides electricity to the entire gas distribution station and makes it independent from external power sources.» The technical performance of projects developed at SPbPU are found to be at the level of the most advanced analogues produced by foreign makers but they are much more cost-effective. At this stage, the development engineers are busy securing a utility model patent and implementing their innovations into industrial practice. When D.A. Medvedev wondered who might be interested in such projects, SPbPU Rector A.I. RUDSKOY answered, «Gazprom will think the world of it».



A large part of the exhibition was devoted to SPbPU research efforts in the medical field.

Dmitry Medvedev was shown a titanium hip joint replacement grown using additive technologies- SPbPU was the first in Russia to apply additive technologies to the manufacturing of high-tech medicinal products.

The sample in question is unique as it is made of Russian-produced titanium powder with the help of SPbPU designed additive technologies that are soon to be patented. According to the development engineers, the only suppliers of such products in today’s market are France and Germany. So, as there are over 1000 replacement surgeries performed in Russia every year, the Polytechnic University took up the task of introducing additive technologies into Russian health care facilities within the framework of the import substitution program..

At the display booth of the Molecular Neurodegeneration Laboratory (established in 2012 as part of the Megagrant program; the laboratory specializes in research on the molecular mechanisms of Alzheimer’s disease and other neurodegenerative disorders), Prime Minister was informed that it required five years to develop the prototype drug to treat mental debility, and the drug is now undergoing preclinical evaluation. At this moment, the laboratory continues to conduct research under the National Technology Initiative (NTI), a group of NeuroNet. One of the laboratory’s inventions is an HIV/AIDS vaccine called «DNK-4», but it also developed some prototype drugs for Alzheimer’s disease. The Chairmen of the Government emphasized the significance of these research efforts and pointed out that there are downsides to current medications for treating such diseases. «Pursuing rigorous research on Alzheimer’s medications, Polytech increases its chances of winning a Nobel Prize,» SPbPU Rector A.I.Rudskoy remarked enthusiastically.

Operative intervention without wounds or scarring – is it even possible? «Yes!» claim the staff of the Laboratory of Medical Ultrasound Equipment at SPbPU. They have been engaged in the development of diagnostic and therapeutic technologies and their combination, which resulted in the creation of a methodology and hardware-software complex to automate surgical treatment. «This project is aimed at designing a hardware-software complex that consists of diagnostic and therapeutic modules capable of directing and focusing high-intensity ultrasound, performing ablation and visualizing the results of the effects of ultrasound on

diseased areas», the scientists commented. Thus, they invented a new nonsurgical method of treating varicose veins, oncological diseases, etc. Moreover, Prime Minister was shown a machine designed at SPbPU that allows delivering nanomedicines directly to affected organs.

At the display booth of the Research and Innovation Complex «Nanobiotechnologies», Prime Minister was told that Polytech scientists are involved in both fundamental research on the key processes of cellular activity and applied research on new CRISPR systems to create advanced genetic engineering technologies as well as the search for and development of new antibiotics. The state-of-the-art equipment, «Laser Tweezers» as an example, allows scientists to experiment on individual biological molecules (for instance, DNA). It is noteworthy that it is the first time when this method is implemented in Russia. Research is carried out in collaboration with the leading Russian and international scientific centers – the Petersburg Nuclear Physics Institute, Institute of Gene Biology, Institute of Molecular Biology, Paul Sabatier University in Toulouse, Rutgers University in New Jersey, etc. One of the major avenues for applied research is the search for and development of new peptide-based antibiotics and bioactive components (peptides are small protein fragments). As of now, there is a patent being obtained on a new peptidic family of over 700000 new antibacterial agents.

At the display booth of the Department of Integrated Electronic Systems of the Institute of Physics, Nanotechnology and Telecommunications, Chair and Professor A.S. KOROTKOV elaborated on current developments for medical applications. By the way of example, the unique Doppler spectral analyzer used to extract blood flow velocity information can exceed twice the limits for assessing velocity by depth, as compared to its analogues. The invention has been patented in the Russian Federation. Then, a new system to prevent the onset of decompression sickness was developed and tested. Next, a prototype for the visual display unit to assess cerebral blood flow was designed. It is also one of the kind in Russia. Finally, cross-platform software to monitor blood flow that allows for further statistical analysis was developed.

Minister of Healthcare V.I. SKVORTSOVA, who was mostly interested in SPbPU developments for biomedical applications, commented (watch her video interview) on a wide range of research projects and their advanced level: «Pharmaceutical projects, especially in the area of therapeutic vaccines and new gene therapeutic approaches, are of particular interest. This promising research direction must be pursued with vigor. I am very impressed. All young scientists engaged in this work are doing a great job. I want to wish you all every success in your efforts.»

Among the projects presented to D.A. Medvedev, special emphasis was put on promising developments in the military-industrial complex and the cooperation of the University with MIC enterprises. For instance, the strategic partnership of the Polytechnic University and «Concern «Granit-Electron» JSC led to the establishment of the Specialized Department of Computer Hardware and Software Systems. Apart from training skilled staff for defense contractors, the department has a known potential for the follow-on development of the homing device. Cruise missiles fitted with homing heads produced by the Concern are a perfect example of the most

advanced high-precision strike weapon. Such an approach makes it possible to ensure a sustainable competitive advantage in regard to the development of state-of-the-art equipment for military and civilian use. In addition, the cooperation of the Polytechnic University and Concern «Granit-Electron» in fundamental scientific research resulted in the creation of a new-generation gamma unit for radiotherapy «Rokus - R». The project is executed under the «PharmaMed-2020» program and meant to facilitate import substitution in respect of medical equipment.

O.E. KVASHENKINA, Assistant Professor at the Department of Radio Engineering and Telecommunication Systems, presented a satellite mockup designed at the Institute of Physics, Nanotechnology and Telecommunications: «The satellite sheath and electronics inside were produced using advanced nanotechnologies. This is one of the thirty satellites comprising the Space-based Automatic Identification System, the first of its kind in Russia. The system is aimed at developing MariNet and SafeNet markets under the National Technology Initiative.» It should be noted that the project is carried out with support from enterprises linked to Roskosmos, such as Arsenal Machine-Building Plant Open JSC and Frunze KB Arsenal. The scientist made a point that when the whole set of nanosatellites is launched into a low orbit, the system will allow tracking all commercial sea craft and determining their type, route and speed in real-time mode. The data will be available to logistics companies and private users. The system will help enhance the safety of traffic in the open seas and assist in navigation within seaport areas.

In conclusion, the Chairman of the Government examined Supercomputer Center «Polytechnic».

Media Center, SPbPU

Дата публикации: 2016.07.02

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