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Trepang: Protecting Marine Ecology in the Far East

Skolkovo Foundation News, 13 November 2020

Authorities in Primorsky Krai, a province in the far east of Russia on the Pacific coast, are discussing the construction of a chemical fertilizer plant in the Nakhodka region. The famous hydro-biologist Sergei Maslennikov, who is also head of a leading Skolkovo startup, is taking part in developing an ecological safety concept for the enterprise.

Morskoi Biotechnopark, a Skolkovo Foundation resident of the biomedical cluster, which creates a line of highly productive far eastern trepang (a.k.a. sea cucumber) using modern selective genetic breeding methods. The trepang is a marine invertebrate that is often harvested for food in many parts of the world but which, as we shall see, is not just limited to that.

The company's researches are not just limited to trepang, however, the firm is involved in the development and implementation of marine aquaculture technologies for bivalves (molluscs), echinoderms (starfish belong to this category), crustaceans and seaweed, thus generating live feed for sea-farming. The company is also involved in creating hydro-biotechnical installations for sea-farming and controlling biofouling (accumulation of microorganisms, plants, etc. on wetted mechanical surfaces) on ships and hydraulic structures; it conducts research in benthic organisms, plankton and biofouling, studies the biology of invertebrates and algae, develops strategies for the development of marine aquaculture in regional coastal zones, develops projects for aquaculture farms and implements new technologies.

Sk.ru has already covered a number of team projects headed by Mr. Maslennikov, the senior researcher at the A.V. Zhirmunsky National Scientific Center of Marine Biology in Russia's far east. One of the projects covers genome selection in trepangs, while another focuses on producing hardy offspring from the Japanese spider crab.

With regards to the plans for a chemical fertilizer plant and its potential negative impact on marine life in Nakhodka Bay, scientists are convinced that part of the system should incorporate a plantation of cultivated bio-organisms. These can be used to give early warning signs of a contamination problem, allowing time to solve it. Similar technologies are known, but they have advanced much in recent years and have become cheaper and more efficient

The main impact on marine life in Nakhodka Bay is caused by the presence of two large ports – Vostochniy, which handles coal shipments, and Kozmino, which is home to an oil loading terminal. On the other side of the bay is Nakhodka port, which also handles coal shipments. If that isn't enough for marine life, biproducts from agriculture also end up in the bay as well as domestic waste-water from nearby towns and villages. In order to create an effective solution for ecological safety, the team

will study the water column, the sea floor and conduct background research.

Because there are so many influencing factors, the first stage of the solution should involve creating a rectangular grid of observation stations – a total of 25 points standing adjacent to the coastline and right opposite the industrial facility under construction.

Based on data analysis from these stations, it will be possible to observe the direction of water mass and to measure the impact of surrounding facilities. However, technogenic impact should be separated from natural phenomena, which can be several times greater than anthropogenic impact. In order to do this, a control station should be installed in the waters of the Vostok Bay marine reserve where there is no industrial activity. If there are any global interannual natural changes, they will affect local marine organisms and these will show.

The next step is to create a continual monitoring system for the ecosystem. Key indicators are that organisms die out quickly in an unsuitable environment, do not breed, or they leave it.

That is what has happened to scallops, far eastern trepang, and grey sea urchin. Scallops can only tolerate pollution for half an hour; any longer than that and they open their shells, making them vulnerable to predators. Under such conditions, the grey sea urchin stops growing and breeding, while the trepang quickly loses its body mass due to the phenomenon of negative growth. Since monitoring the quality and weight characteristics of hydrobionts is easy and inexpensive, they can serve as tools for assessing the impact of water quality.

Another use for hydrobionts is to create mariculture-hydrobiont plantations for sanitation that can clean both water and soil, as well as process pollutants in the water area. This process is called bio-remediation. An example of this is the Pacific mussel, which is able to live for some time in an oil slick; it is considered around the world to be a water purifier. Brown and red algae also bind heavy metals. The only disadvantage of this method is that the purification process in this case takes some time. However, the main purpose of such plantations is to quickly detect contamination early on based on the growth levels of cultivated hydrobionts.

Group-IB Launches New Class of Solution Against Cyber crime

Skolkovo News, 25 November 2020

Group-IB unveiled its new system titled Threat Intelligence & Attribution at the CyberCrimeCon20 conference. According to the Skolkovo resident, the system is the first of its kind and is designed to map out and hunt threats on a company-specific basis.

During two sessions, Group-IB's co-founder and Chief Technical Officer, Dmitry Volkov, presented on the current trends in cybercrime before doing a demo of the new Threat Intelligence & Attribution system. According to Mr. Volkov, ransomware affiliate programs increased by 50% from 2019-2020, changing the cybercrime markets as cybercriminals shift their attention away from individuals to big companies. Due to this increased popularity, the largest banking botnet operators have joined these affiliate programs and are deploying

ransomware, including well known banking botnets such as Silent Night, Qbot, TrickBot, and RTM.

The largest single ransomware case this year broke the records with a demand of $10 million from a government company. In spite of this, public domain information shows that only 62 out of 2500 (2.5% approx.) network encryptions by TrickBot botnet owners were reported publicly. TrickBot botnet has been described as one of today's top-3 most successful Malware-as-a-Service (MaaS) operations in the cybercrime underworld according to ZDNet; while the lack of publicly reported incidents inhibits the ability to know precisely the damage ransomware has done over the last year, Group-IB estimates that it is over $1 billion. One of the most high-profile ransomware cases in recent years is the WannaCry ransomware outbreak in 2017, which spread across the world affecting over 200,000 computers in 150 countries and causing around $4 billion in losses.

Threat Intelligence & Attribution

As of 2020, a new trend has been to sell access to compromised companies online; that is to say, sell access to compromised corporate networks. During his presentation, Mr. Volkov said that although the market size in 2018 was just $1.6 million, this has nearly quadrupled to $6.1 million as of 2020. Nearly a third of compromised companies are located in the United States, while the rest that are in the top-5 are located in Europe. In terms of category, the most targeted are governmental, educational, IT, manufacturing and healthcare companies. As the market size has increased, so too has the number of sellers of compromised networks, making this a very real threat to the integrity of companies' networks across the world.

Where does Threat Intelligence & Attribution come in? In short, it is a tool that compiles a tailored threat map for each client, while actively hunting attackers. It shows threats that are specific to a company, its partners and clients, industry threats (threats to the industry specific to the client), and can tell if threat actors are of the cybercriminal or nation state categories.

To create such a threat landscape, high quality profiling on threat actors is necessary, according to Mr. Volkov. As mentioned, threat actors are divided into two categories: cybercriminals and nation states. Under these two are the lists of detected threat actors, and during the demo, Mr. Volkov selected a China-based group from the cybercriminal category. TI&A then displayed the list of attacks the group has been involved in, including the target countries, the target sectors, time stamps, the group's main attack course, alternative names of the group, and so on.

In this way, TI&A offers security teams the tools to connect "events" surrounding an attack, attribute threats, analyze malicious code and respond to an incident promptly, while the smart ecosystem is designed to automatically halt targeted attacks on a given organization.

"The majority of attacks on an organization should be able to be stopped automatically, but this is still not enough," said Mr. Volkov during an interview with Sk.ru. "With time, money and intelligence, cybercriminals will learn to overcome automated detection systems. We must be prepared to gain experience through hunting while using 'sharpened tools.' Simply blocking is not enough, because tomorrow you will be attacked again based on how you stopped the attack today. Hunting is a continuous process based on huge amounts of data such as system events and traffic meta-data, domains, hosts, and profiles of the attacking groups. To work with this, you need a 'third hunter,' one that hunts cyber threats and hackers. That is the future of cybersecurity."

The Group-IB engineering team was guided by several principles while creating the technology.

Firstly, the system and detection algorithms should "know" cybercriminals, while cybersecurity specialists should get either a good technical justification or a full intelligence context of the threat – that is, who is attacking, what are the attackers' motives, what tactics are being employed, what tools are being used and what could potentially be used in further attacks. The security system should efficiently detect and quickly block the threat, even though nowadays that isn't enough. Detection is just the beginning when it comes to creating working cybersecurity strategies.

Secondly, the process of data enrichment of current security systems should be automated. For this, the analysis mechanism moves beyond simple threat detection. It is extremely important to fully extract and run malicious code in isolation; in doing this, you can collect an array of indicators that will help with hunting for further threats in the network.

Group-IB's Threat Hunting Framework is a universal solution for IT and service networks whose main tasks are to detect unknown threats and full-on attacks earlier, find both internal and external threats, and also investigate and respond to cybersecurity incidents. The Threat Hunting Framework architecture includes several main functional modules.

One of these is Sensor, which is used to uncover threats on a network level using a deep analysis of network traffic; meanwhile Sensor Industrial, a separate module, can protect a service network from full-on attacks. It provides integrity control of the software and firmware automatic process control system by analyzing industrial protocols and comprehensive network protection using machine learning, thus detecting threats that have customized protocols and classifiers.

Another Group-IB innovation is a platform called Polygon, which is designed to "detonate" malicious code. It detects threats by doing behavioral analyses on emails, files and link content; it isolates the malicious code, which causes it to "detonate," allowing you to get indicators of attack (IoA) and to perform an attribution of the detected threat.

Group-IB also presented an innovative protection for user work-stations called Huntpoint. This module creates a full chronology of events on an employee's computer, uncovering anomalous events, blocking malicious files, immediately isolating the attacked host, and collecting important criminal data for further investigation.

Meanwhile, Huntbox is responsible for the fully automated analysis and correlation of events in a given network. The module provides a full map of events inside and outside a company network, helping to hunt for threats and uncover the activities of attacking groups that are targeting the company.

Threat Intelligence & Attribution has taken Group-IB to new levels, as it operates on a high-load capacity of data on hacker groups, their tools and their infrastructure. The appearance of TI&A on the market signals the advent of a new class of solution designed to collect data on threats and attacks that are relevant to specific organizations, investigate and hunt hackers, and protect network infrastructure.

Combining unique data sources, experience in investigating high-tech crimes and responding to complex multi-stage attacks across the world, TI&A acts as a pipeline of information for other Group-IB products that are actively hunting attackers and threats. The system secures data on hackers and their connections, domains, IP, infrastructure for 15 years, including those that criminals attempted to delete. Its broad functionality means that it can be adjusted to the threat landscape not just for a particular industry, but for a specific company in a specific country.

The TI&A "system ideology" focuses on not just identifying the threat but on finding out who is behind it. The masses of data that it operates allow it to quickly link an attack to a specific group or individual. It is able to analyze and attribute threats that a company has already faced, detect leaks and compromised users, identify insiders that are trading company data on underground web soucrces, and uncover and block attacks targeting the company and its clients, regardless of the sector.

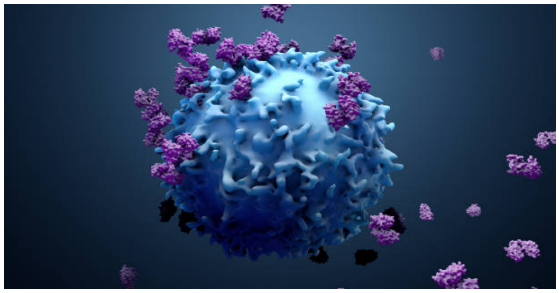
TI&A's entrance onto the market will offer access to Group-IB's internal tools, which until now were used exclusively by the company's response, hunting and cyber intelligence teams. Now, every specialist using TI&A can search through the largest collection of data on the dark web – an advanced profiling model of hacker groups and a fully automated graph analysis that can correlate data and attribute threats to a specific criminal group or individual in a matter of seconds.

TI&A detects attacks that traditional security methods do not protect against, offers a deeper understanding of the methods of high-level attackers, and assesses whether or not the protected infrastructure can resist them. This approach motivates and improves the efficacy of internal cybersecurity teams, while enhancing their expertise by providing a deep understanding of the threat landscape.

Russian scientists discover way to diagnose cancer and other diseases with a single drop of blood

Samara University news, 05 November 2020

Published in the peer-reviewed, US-based Journal of Raman Spectroscopy, the research details how blood can be analyzed by looking at how light interacts with molecules in the liquid. The technique can also rapidly test for many other diseases, which normally require hours to be diagnosed in laboratories. "Light interacts with biological molecules, the building blocks of our body,"said Ivan Bratchenko, an associate professor at Samara University, the institution that developed the method alongside specialists from the nearby Samara State Medical University. "If you know exactly how this interaction occurs, you can track how the body's composition changes, and whether any



pathologies exist in a single drop of blood."

According to experts, this method of diagnosis is less accurate than testing in a laboratory, but is faster, can be done using portable equipment, and can be used to perform mass screenings.

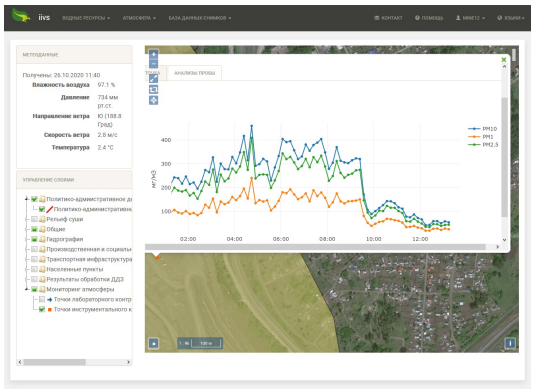
"Using a liquid biopsy, you can quickly identify people who are just beginning to develop a pathology, and send them to the appropriate specialist," the professor said. "You can also monitor the condition of patients who are already undergoing treatment."

Samara University is one of the country's leading institutions and, during the Soviet period, when the city was known as Kuybyshev, was famed for its work with the space program. In 1966, when it was then known as the Kuibyshev Aviation Institute, it was named after Sergey Korolev, a rocket engineer who played a prominent role in the Space Race. Earlier this

year, scientists from the university created a biomaterial to restore bones in sufferers of osteoporosis.

NSTU NETI students developed the system of environmental monitoring aimed at registering the level of pollution in Kuzbass and Krasnoyarsk

Novosibirsk State Technical University news, 18 November 2020



The successful tests of the updated environmental monitoring system developed by Novosibirsk students were completed in Kuzbass on 16 Nov 20. The projects 'VectorAIr' hardware and software system now not only remotely collects and transmits data about air pollution to the server in real time via wireless connection, but it can also predict the distribution zones of pollution and analyze the contribution of each individual source to the overall level of pollution. The results of the tests proved the motorway to be the main source of pollution.

The project was carried out with Kemerovo Branch of the Federal Research Center for Information and Computational Technologies (KB FRC ICT). The VectorAIr hardware and software system allows collecting and transmitting data about contamination to the server in real time remotely for a customer. The system monitors and analyzes current concentration indicators of small, medium and large airborne particles, as well as the information of ozone, sulfur dioxide, nitrogen dioxide and carbon monoxide amount. The use of a multifunctional wireless monitoring system is possible not only in environmental application, but also in construction, agriculture and energy.

In early October, NSTU NETI students completed upgrading environmental monitoring system: they changed the devices' hardware and upgraded the complex's software part. Field trials of the updated system were conducted at coal mines in the Kemerovo Oblast. Their results confirmed that the hardware and software complex has improved the quality of measurements, since there is a new function for calculating pollution zones based on the air quality index and the number of recorded parameters is expanded. Currently, the VectorAIr system can detect dust particles of nitrogen dioxide, sulfur dioxide, ozone, carbon monoxide less than 2.5 micrometers in size, and such parameters as temperature, pressure and humidity.

Due to the use of AI, the program can also predict the distribution zones of atmospheric pollution. According to the developers, this enables a correct allocation of the state and companies resources, so that they could get the maximum improvement in air quality with minimal investment in protective and treatment facilities. During piloting the system, the students found out that the motorway was the main pollutant in the surveyed area.

"Previously, the information about air pollution was collected several times a month, so the data was not so relevant, and the methods of transmitting this data did not allow processing it with our software. In order to solve this

problem, we needed a monitoring system that would gather information about real time pollution," says Ivan Kharlampenkov, PhD (Technical Sciences), a researcher at the KB FRC ICT.

Unlike the existing devices, VectorAIr collects data to the server automatically and works without connecting to the power grid. It also contains only industrial sensors. The hardware and software system developed by students consists of a base station and data acquisition devices. The devices receive data from sensors and transmit it to the base station over the LoRa wireless communication. The base station generates an information package and sends it via GPRS to the customer's server every 1-2 hours.

The solution reduces the dependence on cellular communication by gathering data using the LoRa Protocol, thereby increasing the coverage of the territory of the examined object to 10 km and reducing the constant financial expenditure for mobile operators to a minimum, according to the authors of the development.

Taking into account the experience and results obtained, the participants of the NSTU NETI business incubator plan to use the VectorAIr complex in Krasnoyarsk. Our task will be to determine the impact of each plant on the overall level of pollution and test the hypothesis about the main polluter. We have already encountered a similar situation when using VectorAIr in Kemerovo Oblast. Everyone believed that the main polluter is the CHPP, but a detailed analysis revealed that the motorway is the main pollution factor," said Vladimir Radchenko, a graduate student of Radio Engineering and Electronics Faculty, NSTU NETI, a resident of the Garage Business Incubator and a Chief Technology Officer of the VectorAIr project. The issue was also highlighted during the event "The Day of Business and Economic Partnership between Novosibirsk and Krasnoyarsk", which is scheduled for November18 — 20, 2020.

"We think that the close collaboration between NSTU NETI, Kuznetsk Center of Technical and Environmental Expertise and KB FRC ICT can find the optimal solution which will not only stop the pollution of the city, but also will facilitate investing in the infrastructure objects that are not actually contaminants", said Vladimir Radchenko.

The advantage of the VectorAIr development the will be economical benefits of its implementation. The use of wireless technologies and the system's autonomy will reduce human and financial costs as well as time. The monitoring costs will reduce to about a fifth of the existing technologies.

According to the report of the analytical service of the international audit and consulting FinExpertiza, Russian enterprises and transport released 22.7 million tons of pollutants into the atmosphere in 2019. On average, a Russian citizen receives about 155 kg of harmful emissions per year. This figure ranges from 23 kg to 1.6 tons depending on the region, experts say.

According to 2019's regulation of the Russian Government, the objects listed in it should ensure the transfer of information to Roskomnadzor about emissions of environmental pollutants by 2022. Scientists have found out that there is no minimum threshold for pollution that does not affect health. The consequences of the polluted air exposure can include allergic reactions, complicated asthma, irritation of the mucous membranes, cancer and other diseases.

TPU Scientists Develop Eco-friendly Hydrogel for Agriculture

Tomsk Polytechnic University news, 30 November 2020

Scientists of Tomsk Polytechnic University, in cooperation with the Czech colleagues have developed a new hydrogel for agriculture. It is meant to retain moisture and fertilizers in soil. The difference of the new hydrogel from other formulations is that it is made entirely of natural components and degrades in soil into nontoxic products to humans, animals, and plants. Hydrogels are used in agriculture and forestry to retain moisture in soil, which directly affects germination. They are also used in combination with fertilizers as hydrogels reduce volatilization of fertilizers and therefore control fertilizer release.

“Due to the hydrogels, plants require less watering and fertilization. On the one hand, it is important for fresh water conservation on the planet, on the other hand, it reduces the harmful effect of fertilizers to the soil. Most of the hydrogels available on the market are made of polyacrylamide and polyacrinolintrile. They are not fully biodegradable, that is why they are considered potential soil contaminants. Even though the components themselves are not toxic, their commercial formulations contain residual amounts of acrylamide, which is a neurotoxic and carcinogen substance.

The process of obtaining the hydrogel suggested by the Russian researchers is simple: the primary components must be mixed in a solution, dried, and compressed into a tablet. In contact with liquids, the substance swells and becomes gel-like.

> *We used whey protein and alginic acid as primary components in our research work. These are affordable, natural and completely non-toxic components. This is the main advantage of our hydrogel,”*

Antonio Di Martino, one of the article authors, associate professor of the TPU Research School of Chemistry and Applied Biomedical Sciences, describes, **“**We also added urea in the mixture which is a well-known fertilizer. Over time, the hydrogel degrades in soil gradually and evenly releasing the fertilizer. Moreover, the hydrogel itself degrades into carbon and nitrogen over time, while nitrogen is a widely used macronutrient in agriculture and an essential structural material for plants. The laboratory experiments showed that the hydrogel can be used a few more times after a full release of moisture,”

In the future, the scientists will continue experimenting and searching for new materials for a controlled application of fertilizers in soil. The scientists from Tomas Bata University in Zlín (the Czech Republic), Dairy Research Institute (the Czech Republic), and Research Institute for Soil and Water Conservation (the Czech Republic) also took part in the research project.

Ural Scientists Create a Model of a Highly Efficient and Safe Lithium-Ion Microbattery Cell

Ural Federal University news, 08 December 2020

The capacity of the stored energy in the prototype micro-battery cell is 10 times greater than that of similar devices Employees of the Institute of High-Temperature Electrochemistry of the Ural Branch of the Russian Academy of Sciences (UB RAS) and the Ural Federal University have created a computer model of the electrochemical cell of a lithium-ion microbattery. The capacity of the stored energy in it is 10 times greater than that of similar devices. The exceptional properties of the cell are the result of using a two-layer silicene on a graphite substrate as an anode element, as well as a solid electrolyte. The scientists published an article with a comparative description of the development in the journal Materials Science and Engineering.

“The difference between our work is that we did not study free-standing, so-called, naked-silicene, to which most theoretical scientific works are devoted, but ultrathin substrates, separately from which silicene cannot be obtained at present. We used a variety of materials as a substrate for silicene, including silver, nickel, copper, and aluminum. It turned out that the most suitable option is a graphite substrate, since the bond between silicene and graphite is rather weak, so graphite does not have a strong effect on two-dimensional silicon, and it largely retains the properties of free-standing silicene,” says the head of the research group, chief researcher of the laboratories electrode processes of the Institute of High Temperatures Ural Branch of the Russian Academy of Sciences and materials and devices for environmentally friendly energy of the Ural Federal University Alexander Galashev.

Moreover, scientists have found that, in combination with a graphite substrate, silicene is prone to metallization. A small electronic conductivity appears in it, which makes the use of silicene in lithium-ion battery cells even more expedient. Another development advantage is its solid-state design.

In addition, the model uses a thin-film electrolyte. In this case, electrical conductivity plays a lesser role than in electrolytes made of dense materials with a thickness measured in microns and even millimeters. The electrical conductivity of the developed cell turned out to be quite high, its theoretical capacity is 3500 mAh / g-1. Consequently, a ready-made battery consisting of several hundred such electrochemical cells will be charged much faster.

“This is a fundamentally important quality, especially for the use of batteries in the automotive industry. Lithium-ion batteries have proven to be more promising than hydrogen fuel cells. However, to date, charging them takes 3-5 hours at best. Thus, the task is to reduce the charging time as much as possible, down to several minutes,” comments Alexander Galashev. It should also be added that the created electrochemical cell is also characterized by small size and low cost.

At present, work is underway at the Chemical-Technological Institute of Ural Federal University to create and test an experimental sample of the developed electrochemical cell. The physical properties of silicene are still poorly studied in experiments, and this adds to the uniqueness of the joint project of IHTE and UrFU. The research was supported by a grant from the Russian Science Foundation (No. 16-13-00061, Fundamentals of the electrochemical synthesis of new electrode materials based on silicon).

Brief on Silicen

The battery capacity depends on the electrode material (cathode and anode) and electrolyte. Complex oxides of transition metals (for example, cobalt, nickel, manganese, etc.) are used as materials for the cathode, and this technology pays off. The main problem is in finding materials for the negative electrode - anode. Traditionally used graphite and its carbon substitutes are characterized by a very small electrical capacity, i.e. the ability to hold charge while charging the battery: six carbon atoms hold only one lithium atom, which is responsible for charge transfer in the battery.

One atom of silicon, the most productive, widespread and cheapest alternative to graphite, holds more than four lithium atoms. Thus, the theoretical capacity of silicon is more than an order of magnitude higher than that of graphite. However, during cycling (charging and discharging the battery), silicon crystals wear out quickly: they change greatly in volume, lose their original structure, become amorphous and collapse. Cracks form in the anode and the battery fails. The destruction becomes less if silicon nanoparticles are used, but they have poor adhesion to the material that holds them (binder), including graphite or graphene.

Discovered in 2010, silicene (a two-dimensional silicon compound similar in structure and electronic properties to graphene) easily interacts with the environment, binding with oxygen. Like silicon, silicene has good electrical capacitance, but it changes its volume slightly during cycling. When used in electronics, it is important that silicene has no point or line defects that alter its electronic properties.

Ural Federal University's Scientists Figured Out How Noise Affects Neural Networks

Ural Federal University news, 07 December 2020

The project "Mathematical modeling and analysis of noise-induced phenomena in biological systems" led by Lev Ryashko was supported by the Russian Science Foundation. Photo: Ilya Safarov.

Physicists of the Ural Federal University studied the effect of noise inside the human body, which interferes with the free transfer of information, on the operation of neural networks. They showed that such an impact can change the state of the system, but it is not always possible to predict exactly what this will lead to. The research results will help not only to improve the work of artificial neural networks, but also to understand various pathological conditions of the brain. Scientists spoke about the work done in the pages of the journal Communications in Nonlinear Science and Numerical Simulation. The study was supported by a grant from the Russian Science Foundation (No. 16-11-10098, Mathematical modeling and analysis of noise-induced phenomena in biological systems).

Systems of interconnected elements are found in almost all areas and are of particular interest as objects of mathematical modeling. They are also neural networks that perform a variety of tasks; their natural prototype is responsible for all our thought processes.

The most common are oscillatory neural networks (in the same brain), consisting of oscillating (oscillating) elements. Processes

inside such systems can be predictable or random - then the network is called stochastic.

However, there is no guarantee that the system will always work smoothly: it can be affected by external noise. This is the name for oscillations of various natures that can change the dynamics of the neural network. For example, in the brain, the functions of system elements are determined by the activity of ion channels that open and close in response to certain signals. Accordingly, they allow or block the flow of ions. But there is always a possibility that the channel may not work "in time" or noise will interfere with the interaction of ions. Depending on the sensitivity, the system can continue in its usual mode, get lost or alter its dynamics altogether.

In this work, scientists analyzed the sensitivity of systems to random influences. Physicists have studied three main options for neural communication and the effect of noise on them: equilibrium subsystems, periodic oscillators, and chaotic oscillators. In the first situation, with an increase in the forces of interconnection, the neural system passes from an equilibrium mode to an oscillatory mode with antiphase dynamics. Random noise that the system "hears" can destroy the synchronization in it. For the second variant, it was proved that even under the influence of noise, the system retains antiphase and in-phase dynamics, while the antiphase regime can become chaotic. The third case is interesting because, with the strengthening of the coupling, chaotic oscillations can transform into regular periodic ones.

Scientists have studied synchronization based only on stochastic systems, and in general, there are about 40 types of neural synchronization. In-phase and anti-phase synchronization plays a major role in how our brains function. Due to the fact that the processes in such interaction can be random, the dynamics of oscillations in such systems is very complex. The synchronization process can also be affected by serious diseases and brain disorders, for example, Parkinson's disease, Alzheimer's disease, epilepsy, tremors.

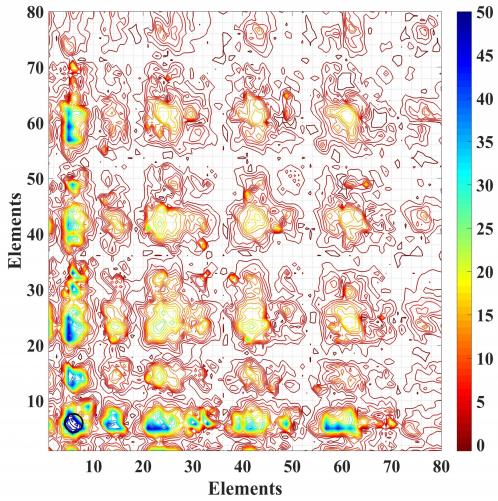
“Our model investigated additive noise and its effect on neural systems. This noise travels through channels in neural networks. But there is also multiplicative noise, we cannot assert exactly what effect it will have on neural connections, and what dynamics it will lead to in a situation where the external noise will be mixed with the internal one. It would be very interesting to make this topic the subject of future work, ”says Lev Ryashko, professor of the Department of Theoretical and Mathematical Physics of the Ural Federal University.

Russian scientists created a chemical space mapping method and cracked the mystery of Mendeleev numbers

Skolkovo Institute of Sciences & Technology news, 05 November 2020

Scientists had long tried to come up with a system for predicting the properties of materials based on their chemical composition until they set sights on the concept of a chemical space which places materials in a reference frame such that neighboring chemical elements and compounds plotted along its axes have similar properties. This idea was first proposed in 1984 by the British physicist, David G. Pettifor, who assigned a Mendeleev number (MN) to each element. Yet the meaning and origin of MNs were unclear. Scientists from the Skolkovo Institute of Science and Technology (Skoltech) puzzled out the physical meaning of the mysterious MNs and suggested calculating them based on the fundamental properties of atoms. They showed that both MNs and the chemical space built around them were more effective than empirical solutions proposed until then.

Their research supported by a grant from the Russian Science Foundation's (RSF) World-class Lab Research Presidential Program was presented in ***The Journal of Physical Chemistry C***. *[https://pubs.acs.org/doi/abs/10.1021/acs.jpcc.0c07857]*



Compound hardness map. Credit: Artem R. Oganov

Systematizing the enormous variety of chemical compounds, both known and hypothetical, and pinpointing those with a particularly interesting property is a tall order. Measuring the properties of all imaginable compounds in experiment or calculating them theoretically is downright impossible, which suggests that the search should be narrowed down to a smaller space.

David G. Pettifor put forward the idea of a chemical space in the attempt to somehow organize the knowledge about material properties. The chemical space is basically a reference frame where elements are plotted along the axes in a certain sequence such that the neighboring elements, for instance Na and K, have similar properties. The points within the space represent compounds, so that the neighbors, for example NaCl and KCl, have similar properties, too. In this setting, one area is occupied by superhard materials and another by ultrasoft ones. Having the chemical space at hand, one could create an algorithm for finding the best material among all possible compounds of all elements. To build their "smart" map, Skoltech scientists, Artem R. Oganov and Zahed Allahyari, came up with their own universal approach that boasts the highest predictive power as compared to the best known methods.

For many years scientists were clueless as to how Pettifor derived his MNs (if not empirically), while their physical meaning remained a nearly "esoteric" mystery for years.

"I had been wondering about what these MNs are for 15 years until I realized that they are most likely rooted in the atom's fundamental properties, such as radius, electronegativity, polarizability, and valence. While valence is variable for many elements, polarizability is strongly correlated with electronegativity. This leaves us with radius and electronegativity which can be reduced to one property through a simple mathematical transformation. And here we go: we obtain an MN that turns out to be the best way to describe all the properties of an atom, and by a single number at that," explains Artem R. Oganov, RSF grant project lead, a professor at Skoltech and MISiS, a Member of the Academia Europaea, a Fellow of the Royal Society of Chemistry (FRSC) and a Fellow of the American Physical Society (APS).

The scientists used the calculated MNs to arrange all the elements in a sequence that posed as the abscissa and ordinate axes at the same time. Each point in space In corresponds to all compounds of the corresponding elements. In this space, using measured or predicted properties of compounds, one can map any specific characteristic, for example, hardness, magnetization, enthalpy of formation, etc. A property map thus produced clearly showed the areas containing the most promising

compounds, such as superhard or magnetic materials.

Russian Immunologists Identify Which Fragments of the SARS-CoV-2 Spike Protein Are Recognised by T Cells of Recovered Patients

Russian Science Foundation news, 09 December 2020

Immunologists at the National Research Centre for Hematology have described regions of the SARS-CoV-2 spike protein. This protein is present in most coronavirus vaccines under development, and its regions trigger the most robust immune response in patients who recover from COVID-19. First of all, the scientists found that the number of T cells that recognize the virus is much higher in people who have never had COVID-19 and whose blood samples were collected in spring 2020 than those whose samples were collected prior to the pandemic. Second, they identified the specific regions of the spike protein that most often trigger a response in immune cells (T cells) of patients who recover from COVID-19. The investigation into the mechanisms of acquired immunity to SARS-CoV-2 is important for the continued development of coronavirus vaccines and methods for diagnosing herd immunity. The results of this work, which was supported by the Russian Science Foundation (RSF), were published [in the prestigious journal *Immunity* (Cell Press).
[https://www.sciencedirect.com/science/article/abs/pii/S016773222036904X?via%3Dihub]

Scientists all over the world are studying the immunological processes associated with the novel SARS-CoV-2 infection. Most patients who recover from COVID-19 have antibodies to the virus but, in some patients, this type of immune response is completely absent. In such cases, T cells – another part of the immune system – could be responsible for eliminating the virus. T cells in most COVID-19 patients can, indeed, recognize virus fragments. But here is the surprising thing: some people who have never had COVID-19 also have T cells that respond to SARS-CoV-2. Researchers at the Centre for Haematology described both types of immune response (antibody- and T-cell-mediated) to the novel coronavirus in three groups of people: those who have recovered from COVID-19, those who never had the disease and those whose blood samples were collected before the pandemic and stored in a biobank.

The scientists analyzed the immune response to spike protein, which enables the virus to enter cells, so it is included in most vaccines being developed to fight SARS-CoV-2. After encountering the protein, the immune system "remembers" it and can neutralize it if it ever enters the body. First of all, it turned out that the number of T cells that recognize the virus is much higher in people who have never had COVID-19 and whose blood samples were collected in spring 2020 than in those whose samples were collected before the pandemic. Authors of the study offer the following explanation: some of those who never developed the disease were probably nevertheless exposed to the virus.

"We don't quite understand the nature of this immune response," comments Alina Shomuradova, the first author of the article and an RSF grantee working at the National Medical Research Centre for Haematology. "T-cell response might be due to activation of immunological memory cells specific to other coronaviruses that were also around before 2019. Or these people, in fact, had subclinical COVID-19 but failed to produce antibodies to the virus."

The most significant result of the work is the identification of the specific regions of spike

protein most likely to trigger a response in the T cells of patients who recover from COVID-19. Two such regions are recognized by the immune systems of most carriers of the most prevalent variant of the HLA-A gene in Europe, which is responsible for the presentation of virus fragments by T cells. Both regions are specific to the novel SARS-CoV-2, i.e., they set it apart from other coronaviruses. This means that they can be used to identify people who have had COVID-19.

The authors also identified which specific T cell receptors recognize individual virus fragments. Thus, the study published by the Russian scientists provides information about viral protein regions that trigger an immune response in humans and about sequences of human immune cell receptors that bind specifically to these regions. This data is important for understanding the interaction between our immune system and SARS-CoV-2 at a fundamental level and for tackling practical problems of diagnosis and vaccination.

Russia Starts Building $850M High-Speed Arctic Internet

The Moscow Times, 19 November 2020

The trans-Arctic underwater fiber optic cable will stretch across 10,000 kilometers from the northwestern port of Murmansk to the Pacific port of Vladivostok.

The Sea and River Transportation Agency (Rosmorrechflot) said it partnered with the Transportation Ministry and state-run port infrastructure firm Rosmorport to provide "local communication line access to the Arctic zone's largest ports and localities."

The project also aims to "create a digital infrastructure for the production and transportation" of fossil fuels and "provide an alternative to satellite communications in northern latitudes," Rosmorrechflot said.

The RBC news website reported that the state is expected to allocate 65 billion rubles ($850 million) for the project. The high-speed Arctic internet contract was reportedly signed in 2019. [https://www.rbc.ru/newspaper/2020/11/19/5fb529779a79472176dda8ed]

It added that the 12,500-kilometer line is expected to provide connection speeds of 52-104 terabits per second.

Andrei Kuropyatnikov, the head of Rosmorrechflot's communications subsidiary Morsvyazsputnik, told RBC the $850 million doesn't account for likely international expansion and construction of additional lines. Kuropyatnikov said the project is not expected to recoup its expenses.

RBC reported that the first leg of the underwater fiber optic communication line is expected to be laid down in 2021. The entire line will be fully built by 2026, it added.

Russia has invested heavily in a shipping lane, known as the Northern Sea Route, that connects Europe and Asia in the fast-melting Arctic.

The government approved the development of the first comprehensive scientific and technical program of the full innovation cycle "Clean coal - green Kuzbass"

Ministry of Education & Science news, 23 October 2020

The corresponding order was signed by the Deputy Prime Minister of the Russian Federation Tatyana Golikova. The proposal for the development of the program, in the formation of which the Ministry of Education and Science of the Russian Federation, the Russian Academy of Sciences, the Ministry of Energy of Russia, as well as interested industrial partners, took direct part, was approved by the Presidium of the Council for Science and Education under the President of the Russian Federation.

The program "Clean Coal - Green Kuzbass" is aimed at creating a set of technologies that contribute to a consistent decrease in the impact on the environment while increasing the efficiency of coal mining and processing. Its implementation will ensure the formation of an effective system of management and synchronization of research, innovation, production and market launch of high-tech science-intensive products, as well as ensure close cooperation with projects implemented by the Kuzbass world-class scientific and educational center.

"*For the entire Kuzbass, this is an important event that will determine the development of the coal mining region in the global perspective. Scientific and educational center "Kuzbass" is the author of a comprehensive scientific and technical program of the full innovation cycle "Clean coal - Green Kuzbass". 29 projects, which form the basis of the KSTP of the full innovation cycle, are based on modern achievements of science and technology, are resource efficient, have high added value and count on entering the directory of the best available technologies in Russia. All KNTP projects comply with new international environmental standards. For Kuzbass business, this is a confident argument in defense of the carbon tax*, "said Irina Ganieva, director of the ANO Kuzbass Scientific and Educational Center.

Leading scientific institutes and universities took part in the creation of the program: the Federal Research Center for Coal and Coal Chemistry of the Siberian Branch of the Russian Academy of Sciences, the Kemerovo State University, the Institute for the Problems of Integrated Development of the Subsoil of the Russian Academy of Sciences, and others. The customers of the KNTP results are the largest coal mining companies: SDS-Ugol, Stroyservice, Kuzbassrazrezugol.

Temperature Monitoring - Intelligent Security Systems

Photo: Press service of JSC "Elvees-NeoTek"

In 2011, with the participation of RUSNANO, JSC Elvees-NeoTek was established, which over time has become a leading developer and manufacturer of high-tech security systems using image recognition, computer vision, radar, video and thermal imaging.

The company's clients include Gazprom, Transneft, Samsung, Thales, Techno, ITPS, the National Defense Control Center of the Russian Federation, as well as international airports, commercial seaports, hydroelectric power plants and others.

For the first time in Russia, specialists of Elvees-NeoTek produced a VIP-1 processor, only 40 nanometers large. With its use, computer vision systems and analysts are able to distinguish and classify any objects: people, animals, luggage, inscriptions, cars.

The areas of use of such systems are very broad —from ensuring security of strategic objects to counting the number of buyers in the shopping center and monitoring their preferences.

In the spring of 2020, Elvees-NeoTek developed the Rubezh-T system of automatic temperature measurement and control of citizens' movement for continuous monitoring of the temperature condition of people in places of mass congestion in real time and for control of movement of people with potentially dangerous symptoms.

Flexible Electronics

Flexible electronics is a global trend and a fast-growing market that, according to a study by international experts, will double over the next decade and will be worth more than $70 billion a year.

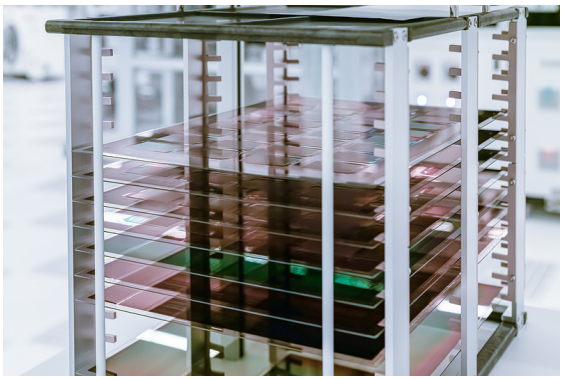


Photo: press service of TechnoSpark Group.

The RFEC has localized the technology for manufacturing flexible organic TFT-matrices developed by FlexEnable (United Kingdom).

In March 2020, RUSNANO opened the Russian Flexible Electronics Center (RFEC) at the TechnoSpark Nanotechnology Center. The RFEC is engaged in the development and small-scale production of flexible components for a variety of electronic devices. Flexible electronics is a platform technology that provides access to a wide range of possible applications and markets. Only five countries, including Russia, have experience in creating and developing products based on flexible electronics technology.

The Center is engaged in prototyping and manufacturing of transistor matrices and flexible integrated circuits based on thin-film plastic electronics for a wide range of radio electronic components—EPD, LCD, and OLED screens, biometric sensors, X-ray detectors, radio frequency tags and sensors.

RUSNANO plans to complete the transfer of the technologies used in the production of flexible oxide-based (or IGZO—Indium Gallium Zink Oxide) TFT matrices and integrated circuits from two R&D centres, IMEC, in Belgium, and the Holst Centre, in the Netherlands, by 2021.

When reaching the design capacity, the production volume will be 25,000 backings per year, which amounts to about 4 thousand square meters of TFT electronics. In terms of their potential application, this is equivalent to 1.5 million TFT matrices for small screens (digital price tags or smart cards), or 100,000 TFT matrices for tablet-sized displays, or 100,000 TFT matrices for palm-sized sensors for biometric authentication, or 100 million plastic chips for RFID tags.

Graphene Nanotubes

A startup from Novosibirsk Akademgorodok, which essentially began with one very ambitious idea: to create a completely new material of the future, has grown into a global market leader with its industrial-scale technologies for production of graphene nanotubes. In 2019, it became the first and, for now, only 'unicorn' in the material based sector from the Russian Federation.

OCSiAl, RUSNANO's portfolio company, announced recently, the launch of a new graphene nanotube synthesis unit Graphetron 50. This launch made OCSiAl the owner of 90% of the world's graphene nanotubes production facilities. Several years ago RUSNANO believed in the prospects of technology created by domestic scientists, and became the first external investor of OCSiAl.

The company has established production of single wall carbon nanotubes with unique for the world market technical and economic characteristics (the product contains up to 99% single wall carbon nanotubes). The technology developed by OCSiAl made it possible to bring the production of single wall carbon nanotubes to the industrial level and for the first time in the world made their mass introduction economically feasible.

OCSiAl produced its first batch of 1.2 tonnes of graphene nanotubes in 2015, using their Graphetron 1.0 unit. The construction of Graphetron 50 began in Novosibirsk in 2016, at a cost of 1.3 billion rubles. The first Graphetron 1.0 now produces 30 tonnes a year, and the second one—Graphetron 50—produces 50 tonnes of nanotubes a year, both sold on the international market under the brand TUBALL.

OCSiAl products—single wall carbon nanotubes—are universal nanomodifiers that improve mechanical properties, as well as electrical and thermal conductivity of various materials (rubbers, composites, polymers and others). A few years after the launch of the project OCSiAl became the first company worth

more than $1 billion in the RUSNANO portfolio, its revenue in 2019 exceeded $14 million. Since 2014 OCSiAl has shown annual doubling of revenue, and in 2019 the company entered the global lists of the "unicorn" companies of Crunchbase and CB Insights with a capitalization of more than 1 billion dollars. OCSiAl managed not only to implement a unique synthesis technology that has no analogues in the world, but also to offer manufacturers ready-made industrial solutions in the form of suspensions and concentrates based on nanotubes developed at the Materials Prototyping Center in Novosibirsk.

The company's customers include leading manufacturers of tires, silicones, polyurethanes, plastic, composites and equipment for the mining industry.

The biggest benefit from using OCSiAl nanotubes will be in electric cars: the cars' bodies will be lighter, the batteries will be more energy efficient and durable, their range will be greater, and rubber will reduce rolling resistance. The use of TUBALL can make electric vehicles more than 50% more energy-efficient, dealing a serious blow to the internal combustion engine's dominance of the market.

It is believed that Russian OCSiAl is the only company that owns a scalable industrial technology for the production of single wall carbon nanotubes, which allows to produce them at an affordable price for the market.

Early Diagnosis of Oncology

The fight against cancer is one of the key areas of the Russian National Project "Healthcare". Without the investment of private funds and the efforts of innovative business, it will not be possible to achieve the development of modern medicine in Russia, capable of controlling cancer. And one of the main problems is detecting the disease at its early stages.

PET/CT-scanning procedure.

RUSNANO has been able to transfer advanced medical technologies for diagnosis and treatment of cancer to Russia. PET-Technology Company, has established the country's first national network of nuclear medicine centers. At present, there are 16 PET/CT diagnostic centers, where 90% of trials are conducted free of charge under the obligatory medical insurance policy.

PET/CT method is a common standard in diagnostics, used in more than 100 countries of the world. As part of the initiative, there are two radiopharmaceutical production facilities in the cities of Ufa and Yelets equipped with cyclotron complexes, laboratories for synthesis of radiopharmaceuticals, and "CyberKnife" (a stereotactic radiosurgery treatment system).

Since the opening of the first PET-Technology Center, the network has carried out PET/CT diagnostics for more than 180,000 patients, and more than 1.8 thousand people were treated with a CyberKnife.

MedInvestGroup, which now owns PET-Technology, plans to open 40 PET/CT centers and eight production sites by 2024, which by 2025 will make available an advanced diagnostic system for over 40 million people in Russia.

Batteries for Transport and Energy

Renewable energy sector, has seen an active spread of smart energy storage systems based on lithium-ion batteries in power grids, railway and water transport, to create uninterruptible power supply for enterprises.

Hundreds of electric buses and trolleybuses on lithium-ion batteries of the Novosibirsk company Liotech, are already on the Russian roads. Liotech is the only industrial manufacturer of lithium-ion batteries in Russia. The capacity of the plant totals 128 MWh of batteries per year. The main fields of application are electric transport and power engineering.

Recently, Liotech developed energy storage systems for the Hevel solar power plant in the Republic of Bashkortostan. Liotech battery cells as a part of energy storage are already used in hybrid power plants—in Menza village in Zabaikalsky region, in Elbesa village in Gornaya Shoria, at the power plant of Almazy Anabara JSC in the Republic of Sakha (Yakutia), as well as in the Republic of Tyva in Mugur-Aksy and Kyzyl-Khaya villages.

RUSNANO and Energosistemy intend to work together to build five autonomous hybrid power plants in the area of decentralized energy supply of the Republic of Sakha (Yakutia) using the system of energy storage based on Liotech lithium-ion batteries. The power system of Liotech has already been successfully tested and is being operated at the unique mining electric locomotive in the Internatsionalny Mine (Alrosa).

Transmashholding, Russian Railways and RUSNANO signed an agreement on the creation of environmentally friendly shunting locomotives using a hybrid drive based on lithium-ion storage batteries for operation at passenger stations of large cities. Over 130 such locomotives can be built in the next six years.

Russian Railways and Rusenergosbyt, are also installing energy storage systems on the Volkhovstroy-Babaevo section of the Oktyabrskaya railroad, where coal is transported from Kuzbass to Ust-Luga. It is planned that the realization of this project will increase the capacity of the site by almost 40%.

Bauman scientists have developed a new technology for "engraving" crystals for laser infrared spectrometers and other optical scientific instruments

Moscow State Technical University news, 11 December 2020

Thanks to the new technology, the efficiency of the devices can be increased by about 20% due to the fact that the radiation will pass through them with almost no glare or reflection.
The staff of the REC "Photonics and IR-Technology" have been working for several years to improve the efficiency of various optical devices based on infrared lasers.Scientists are developing new types of such emitters and increasing their efficiency.In particular, they create new lasers based on crystals of cadmium, selenium, sulfur and other

substances that are well suited for creating emitters operating in the mid-infrared spectrum.

The scientists processed gallium selenide with very short but powerful laser flashes, which evaporated the upper layers of the crystal at the points where they were directed, leaving a "pattern" of pits and bumps several tens of micrometers in diameter on its surface.Thanks to this, the crystals have become much more transparent, their light transmittance has increased from 77% to 94-97%,depending on the wavelength of infrared-radiation.

“Crystals with our micro-reliefs have 20% higher light transmittance than untreated areas.The results of the research will have direct applied value and will lay the foundation for the creation of new highly efficient nonlinear converters of infrared radiation, ”noted Mikhail Tarabrin, REC employee.

Resonator Necklace: How Scientists Are Struggling to Efficiently Control Light at the Nanoscale

ITMO news, 11 December 2020

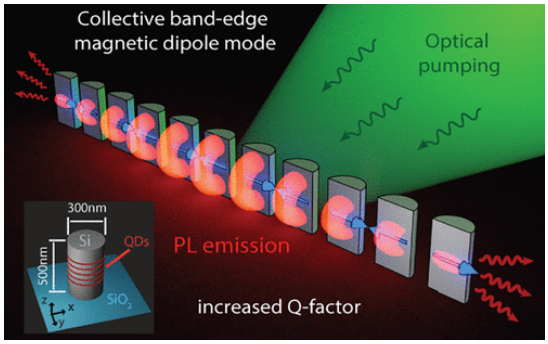
ITMO scientists and their colleagues presented a new principle for creating resonators for lasers.It will allow you to make elements for generating a light signal directly on silicon chips.

Modern technologies cannot be imagined without compact laser systems. They work in various devices, they are used to transfer data, even this article has gone part way from a server to a reader device via fiber optic systems, and small optical devices have helped in this.

However, for the further development of optical technologies, it is necessary to make lasers even more compact. And this is where the problem arises. An important part of a complete laser system is the resonator. This is a device that, as it were, "catches" light and holds it around itself so that it accumulates enough energy to create a laser beam. However, the smaller the device, the more difficult it is for it to hold light long enough, especially when the resonator becomes smaller than the wavelength.

> *“One of the requirements for creating a laser system is that a quantum of light, a photon, lived in a resonator long enough, so it is very difficult to make an effective resonator with a size of the order of or less than a wavelength. The light from such a resonator will simply "crawl out", ”explains* ***Mikhail Petrov,*** *associate professor of the New Physics and Technology Institute at ITMO University.*

Collect in a chain

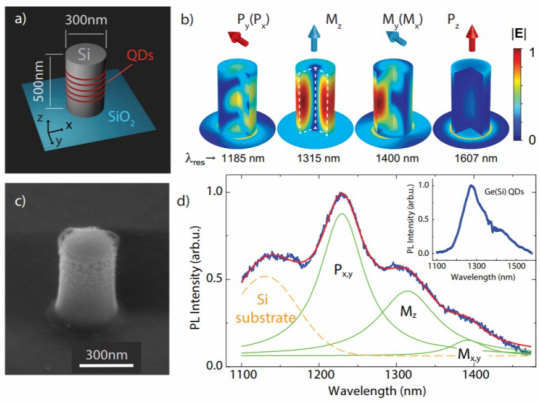


Scientists from ITMO University, together with colleagues from the Nizhny Novgorod Institute for Physics of Microstructures and German partners from the University of Halle-Wittenberg, tried to solve the problem. They decided to get around the limitation by collecting several ultra-compact resonators in one system.

We found out that you can cheat a little and take a very small resonator, but not one, but a whole ensemble, in our case a chain," explains Mikhail Petrov.-You can imagine a chain assembled from weights and springs, and if you touch it, it will keep the energy of movement for a long time due to its vibrations.Here we have implemented a similar principle, the light will os*cillate for a long time in a connected chain of resonators due to the high Q of the collective mode, accumulating energy for laser radiation "*

So far, scientists have shown a system built like a train, when resonators go one after another, like cars in a train. But other geometries are also possible: fan, circular, semicircular, depending on specific tasks.

Reducing size



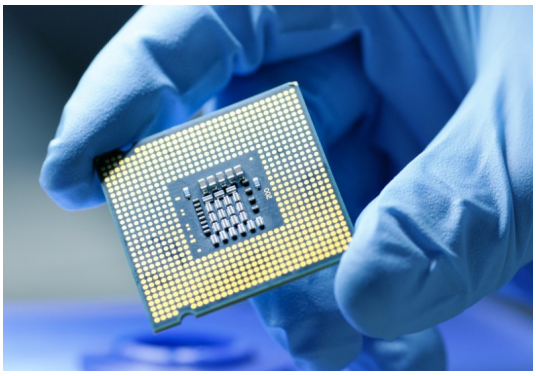
Potentially, the development of scientists can be used to reduce the overall size of laser installations in various devices, including telecommunications. Since it will make their resonator more compact.

So far, there are practically no materials that would make it possible to make single resonators comparable in size to our chain and exceeding them in quality factor," says Mikhail Petrov."Our colleagues in the faculty have recently discovered material that can be used for this in the future, but the technology for it has not *yet been developed."*

However, even if such materials and technologies appear, the proposed approach can be used for them as well, creating ultra-efficient devices.

"When developing the design of the resonators, we actually use an additional degree of freedom, choosing the geometry and changing the arrangement of elements in the ensemble of nanoresonators," adds Mikhail Petrov.

Right on the chip



In their work, the scientists used materials of the device based on elements of group IV - silicon and germanium. This approach allows us to solve another problem - to eliminate the technological "seam" between optoelectronic systems based on semiconductor materials of III-V groups, such as gallium arsenide, and electronic microcircuits manufactured using silicon technology. This will allow in the future to significantly simplify optoelectronic systems, which, among other things, will have a positive effect on the data transfer rate.

"Everything that we have shown can be done entirely on silicon," explains Mikhail Petrov."Nanocavities can be etched on the same

integrated platform on which the electronic system is created, and the necessary electrical wiring can be created there, on the same chip"

In the future, this may simplify and reduce the cost of devices for converting an optical signal into an electronic one and vice versa.

New laser systems

In recent years, researchers around the world have been breaking records for creating the most compact lasers. In this race it was noted and scientists at the University ITMO. However, an important feature is that while these systems need to be "pumped" with energy using the radiation of another laser.

To make full use of such compact lasers, one must learn how to excite them using an electric current, and not by means of laser pumping. This is supposed to be done, in particular, within the framework of work on a new mega grant from ITMO University.

As Mikhail Petrov notes, the development proposed by his group based on an ensemble of nanoresonators can be used for these purposes.
The work was published in the ACS Photonics journal.
[https://pubs.acs.org/doi/full/10.1021/acsphotonics.0c01319?fbclid=IwAR3d3bzlyP5gqBeSLn3kMWlv9ZNNbeziAgfTiiqALhIsE94MZDVIi-vqg_I]

Russian Government releases the Hydrogen energy plan until 2024

"Development of hydrogen energy in the Russian Federation until 2024" is an organizational priority work on the formation in the Russian Federation of high-performance export-oriented field of hydrogen-energy developing on the basis of modern technologies and provided with highly qualified personnel. Achieving the goal of the plan is carried out by improving regulatory framework, formation and implementation of measures by state support of projects for production, storage,transportation and use of hydrogen, strengthening positions for domestic companies in the markets for finished products, as well as carrying out research and development work on critical areas of science and technology.

Currently, one of the challenges to energy security for the Russian Federation is a change in the structure of demand for energy resources, including replacement of hydrocarbons by other types pf energy resources, including hydrogen. Due to the global trend towards decarbonization of the economy, formed by the Paris Agreement, adopted on December 12, 2015. By the 21st session of the Conference of the Parties to the Framework Convention of the Organization United Nations Climate Change, Foreign Countries develop their own programs for the development of hydrogen energy, aimed at

increasing hydrogen production, expanding the use of fuel cells and cars on hydrogen fuel.

The Russian Federation has significant potential in hydrogen energy, namely the proximity to the hydrogen sales markets in Europe and the Asia-Pacific region, resource base (reserves of natural gas, oil, coal, unloaded production facilities of electricity), and scientific groundwork in the field of production,transportation and storage of hydrogen. Thus, it seems appropriate to implement as a set of measures aimed at the successful implementation of projects in the field of hydrogen energy in the Russian Federation, to support research and development work on priority areas for the development of such energy in order to subsequent implementation of the results, as well as to improve regulations and related mechanism of government incentives.

Priority 2030 Strategic Academic Leadership Program

The Russian government has approved the Priority 2030 Strategic Academic Leadership Program, which is aimed at supporting universities. Agree with the proposal of the Ministry of Education and Science of Russia, agreed with the Ministry of Economic Development of Russia and the Ministry of Finance of Russia, on the implementation in 2021-2030 of a strategic academic leadership program (Priority 2030 program) aimed at supporting development programs for educational institutions of higher education," mentioned in the official documents .

Universities under this program will be allocated grants in the form of subsidies for development programs. They will be implemented including jointly with scientific organizations.

The estimated implementation period of the program is 10 years, it will take place in two stages: 2021-2025 and 2025-2030. It is expected that at the first stage up to 120 universities will be selected for it. From 2021 to 2024, about 52 billion rubles will be allocated under the new program for the development of universities.

Universities will be provided with grants in the form of subsidies for development programs, development of material and technical conditions for the implementation of educational, scientific, creative, social and humanitarian activities of educational organizations.

Developing the human resources of the higher education system, the research and development sector by ensuring the reproduction of managerial and scientific-pedagogical personnel, attracting leading scientists and practitioners to universities. Implementation of programs for intra-Russian academic mobility of scientific and pedagogical workers and students, including for the purpose of conducting joint scientific research, implementing creative and social and humanitarian projects, attracting foreign citizens to study at Russian universities and promoting the employment for the best among them in the Russian Federation.

Russia declares 2021 as the Year of Science & Technology

December 28, 2020

On December 25, Russian President Vladimir Putin signed a decree on holding the Year of Science and Technology in the Russian Federation in 2021.

Earlier, 2021 was planned to be declared the Year of Children's Tourism.

The beginning of events dedicated to the Year of Science and Technology is scheduled for February 8, the Day of Russian Science. This was announced by the Deputy Prime Minister of the Russian Federation Dmitry Chernyshenko.

“I think it is symbolic to designate the Day of Russian Science as the starting point for the implementation of the main activities of the plan. It should include events that are necessary and useful for the development of our science, and a separate line - measures to support young scientists,” Dmitry Chernyshenko shared.

According to the Deputy Prime Minister, science should be actively replenished with young talents. It is equally important to create favorable conditions for study and work, as well as opportunities for self-realization of young people.

“Our task is to seriously increase our intellectual potential in order to meet all modern challenges. Now we need to promptly and responsibly prepare for the most important event, mobilize all our forces, ”the press service of the Deputy Prime Minister quotes.

The action plan will be prepared by the Ministry of Education. It should be approved by the end of January 2021, TASS reports.