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# Research Projects

catalogue

# TECHNOLOGY OF WASTE INDUSTRIAL CATALYSTS REGENERATION HYDROTREATING AND TRANSPORTABLE TECHNOLOGY INSTALLATION



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## OBJECTIVES

Reproduction of oil refining waste catalysts activity under mobile conditions without sending them to specialized enterprises



## AREAS OF USE

Industrial Catalysis, Oil Refining



Nowadays duration of single-pass hydrotreatment catalysts lifespan of ecologically clean motor fuels lasts from six months to one and a half year. Qualified regeneration of these catalysts is possible only ex situ, i.e. with transporting deactivated catalyst from reactor to a special regeneration reactor and then to a special hydrotreating reactor. Qualified regeneration of these catalysts for the purpose of almost complete (up to 95 percent) recovery of their activity solves the problem of resource saving, extending their lifespan by 1.5-2 times. The use of a transportable installation for the regeneration of waste catalysts reduces the financial costs of oil refineries associated which suffer from stations downtime.



## PECULIARITIES

Similar or complete analogues of this project are not available on the market.



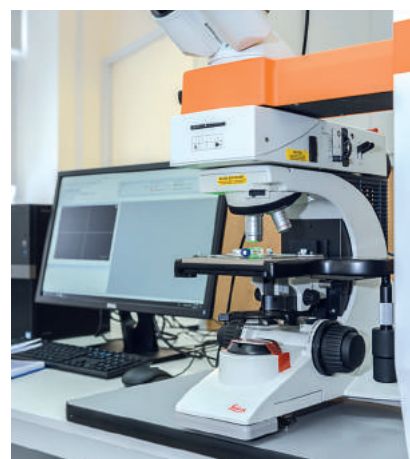
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## CORE COMPETENCIES

#OIL AND RENEWABLE FEEDSTOCKS PROCESSING TECHNOLOGY,  
#CATALYSIS, #PETROCHEMISTRY, #HYDROPROCESSING  
THERMODYNAMICS AND KINETICS



# OIL PRODUCTION INTENSIFICATION TECHNOLOGY



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## OBJECTIVES

Intensification of oil production by oil producing and service companies



## AREAS OF USE

Oil Production

## LEGAL DEFENSE

Patent of the Russian Federation N° 2610952 – Micellar solution for oil production



## PECULIARITIES

The project is devoted to intensification of oil production process in the terrigenous and carbonate reservoirs including high-viscosity oils fields.



The technology of ultrasonic treatment involves layers collectors processing with a powerful ultrasonic field for their filtration features recovery. Processing is carried out on the principle of “inflow profile-stimulation profile”. Production string integrity and cement stone is kept within the process and, what is more, the impact process is safe and environmentally friendly. The technology allows to achieve filtration features recovery of productive layers at the minimum time and material costs without damage to the collector. Surfactant-modified acidic compositions and their application technologies developed in the project allow to process oil-saturated streaks in carbonate reservoirs selectively. The technology of high-viscosity oil production intensification and limitation of water inflow micellar solutions of selective operation is based on different behavior of developed composition in contact with reservoir fluids which results in increasing viscosity in a mixture with highly mineralized water and reducing it in contact with oil.



#### CORE COMPETENCIES

#RESERVOIR RECOVERY, #SURFACE-ACTIVE REAGENT, #MICELLE SOLUTION

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# CATALYST OF OIL FRACTIONS DEEP HYDROTREATING AND ITS PREPARATION METHOD



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## OBJECTIVES

Oil fractions deep hydrotreating



## AREAS OF USE

Oil Refining, Petroleum Chemistry



## LEGAL DEFENSE

Patent of the Russian Federation  
N° 2631424 – Catalyst of Oil  
Fractions Deep Hydrotreating and  
Its Preparation Method

The technical result of this invention is to simplify the method for preparing a high-active catalyst by eliminating from the technology the synthesis stage of 6-molybdenum cobalt or 10-molybdenum cobalt and the use of a simple and cheap molybdenum  $\text{MoO}_3$  compound produced on industrial scale. At the same time, on the stage of preparation of impregnating solution, the formation of a peroxocomplex molybdenum compound. Deep hydrotreating on the proposed catalysts can be carried out in the temperature range of 320-360°C at a relatively low partial pressure of hydrogen and the circulation rate, that allows to reduce the operating costs of hydrotreating.







#### PECULIARITIES

Catalysts are made of domestic materials, have a catalytic activity in the target processes comparable to imported samples.

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#### CORE COMPETENCIES

#PHYSICAL CHEMISTRY, #HETEROGENEOUS CATALYSIS, #OIL REFINING, #PETROCHEMISTRY

# TARGET-ORIENTED APPROACH TO NEW INHIBITORS ION CHANNELS RNA-GENOMIC VIRUSES BASED ON FRAMEWORK STRUCTURE COMPOUNDS



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**Marina V. LEONOVA**, Candidate of Chemical Sciences, Associate Professor, Department of "Organic Chemistry"

**Vadim A. SHIRYAEV**, Candidate of Chemical Sciences, Associate Professor, Department of "Organic Chemistry"

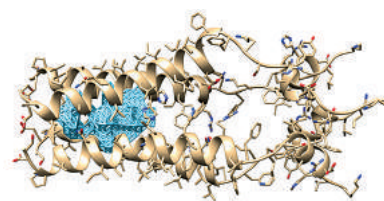
**Marat R. BAJMURATOV**, Candidate of Chemical Sciences, Senior Researcher, Department of "Organic Chemistry"

**Elena A. IVLEVA**, Candidate of Chemical Sciences, Associate Professor, Department of "Organic Chemistry"



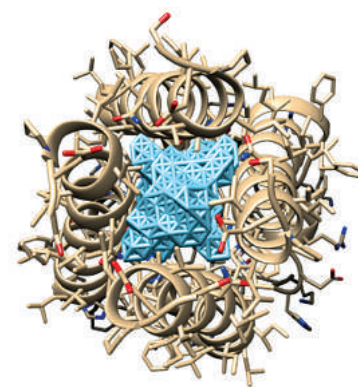
## OBJECTIVES

Computer design of new inhibitors of viral reproduction by virtual screening of frame structure compounds, development of optimal synthesis schemes and detection of anti-virus activity in vitro



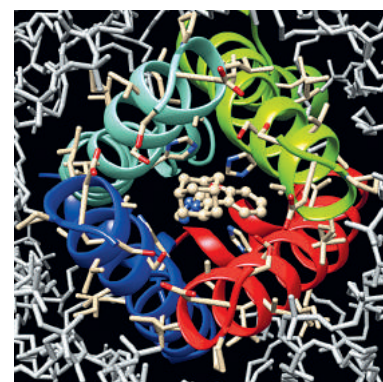
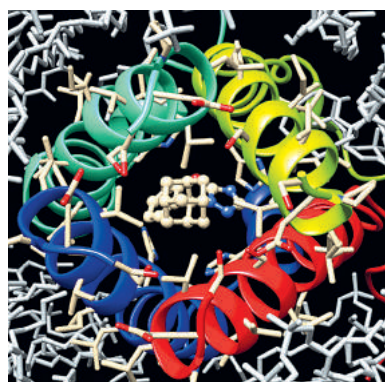
## AREAS OF USE

Chemical Industry, Pharmaceutical Industry, Medical Industry

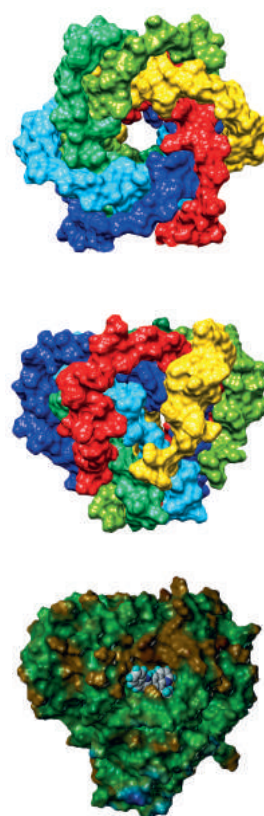


## PECULIARITIES

Computer design of fundamentally new inhibitors reproduction RNA-genomic virus, development of methods for their production and determination of antiviral activity spectrum.



The project is devoted to creation of new orally available potential inhibitors of viral reproduction for further development and clinical studies of compounds. During research models of proteins influenza virus A, Hepatitis C and variola virus were developed and the data about binding of a large array of caged compounds with protein targets was obtained. Moreover, the Project allowed to select the most promising candidates for synthesis and testing of biological activity. Also, new methods of obtaining the most promising candidates of frame structure, a system of modification of polarity of functional groups and variation of steric load responsible for binding molecule centers were developed. Physicochemical characteristics of new synthesized samples (IR and NMR spectroscopy, mass spectrometry, gas-liquid chromatograph, x - ray structural analysis, elementary analysis) are determined. The study also resulted in obtaining data on virus-inhibition action of the synthesized samples in vitro concerning RNA and DNA genome viruses (influenza viruses A and virus of bovine diarrhea as a surrogate model of hepatitis C virus, variola virus). The obtained results are expected to lead to creation of new national pharmaceuticals for various viral diseases therapy. This will allow to reduce the number of ill people among the population of Russia, as well as to solve the problem of import substitution in health care. The Project will also contribute to the development of the pharmaceutical industry through the creation of innovative antiviral agents.



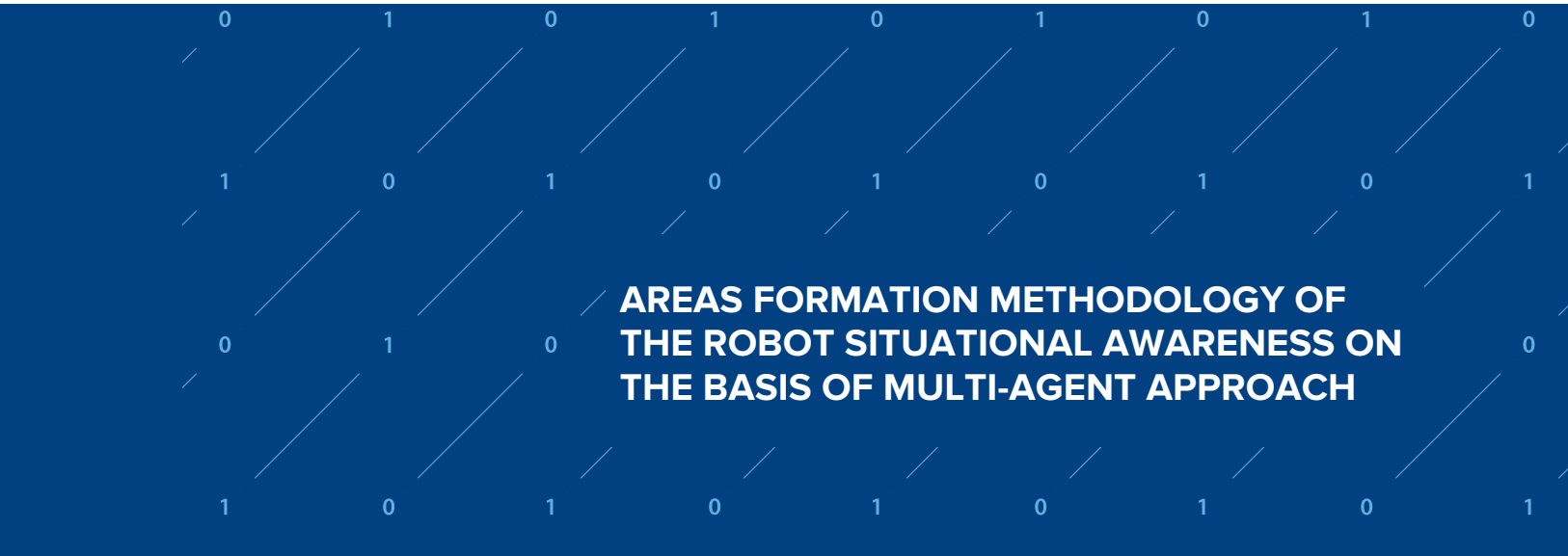
#### CORE COMPETENCIES

#ANTIVIRAL ACTIVITY, # FRAMEWORK STRUCTURE, #DOCKING,  
# MOLECULAR MODELING, # OPTIMAL SYNTHESIS SCHEMES, #VIRAL  
INFECTION, #RESISTIBILITY

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# AREAS FORMATION METHODOLOGY OF THE ROBOT SITUATIONAL AWARENESS ON THE BASIS OF MULTI-AGENT APPROACH



**Aleksandr N. MOCHALKIN,**  
Director of the Regional Scientific  
Center “Information Security”



**OBJECTIVES**  
Monitoring of water, air and surface areas for scientific civilian and military purposes using groups of diverse robotic vehicles (unmanned aerial vehicles, autonomous uninhabited underwater vehicles, surface robots) and the creation of a situational awareness knowledge base



**AREAS OF USE**  
Ecology, Agriculture, Fishing, Extraction of Mineral Resources, Military Industry (Dual-Use Technology)

**IMPLEMENTATION**  
The project is being tested for dual-use tasks.

The area formation methodology of “group situational awareness” in the water areas is formed due to the capabilities of technical facilities of monitoring and assessing the environment state of all participating control objects that are presented in the form of hardware and software agents.



**PECULIARITIES**  
For the first time unmanned aerial vehicle and autonomous uninhabited surface-underwater unit were combined together in a module construction. Multi-agent system of situational awareness was developed.



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**CORE COMPETENCIES**  
#SITUATIONAL AWARENESS, #MULTI-AGENT TECHNOLOGIES, #UNMANNED AERIAL VEHICLES, #AUTONOMOUS UNINHABITED UNDERWATER VEHICLES, #SURFACE ROBOTS

# AUTONOMOUS UNMANNED UNDERWATER VEHICLE OF HYBRID TYPE “MAKO”



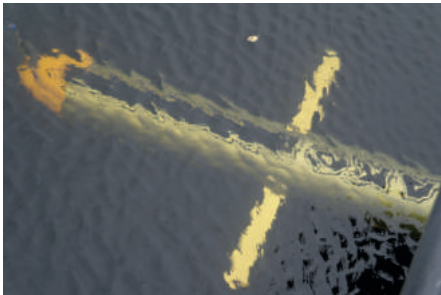
**Maxim V. NENASHEV**, Doctor of Technical Sciences, First Vice-Rector and Vice-Rector of Academic Research



**OBJECTIVES**  
Oceanological research, underwater monitoring, search, identification, reconnaissance, monitoring and inspection of underwater civil and military targets, underground mine warfare and countermeasures



**AREAS OF USE**  
Oceanology, Hydrometeorology, Military Industry



The device has a torpedo shape with wings and locomotors. It includes measuring, photo, video, hydroacoustic, navigation and other equipment, as well as a battery and a hydraulic system for changing buoyancy. The device is characterized by easy deployability, a high degree of navigation and work autonomy and low noise of movement. It can reach speeds in the planning mode up to 2-3 knots, dive to a depth of up to 2000 meters and work in shallow water and under ice.



**PECULIARITIES**  
The development presents an innovative system for changing buoyancy, allowing the device to move both in the mode of glider (planning) and with the switched on locomotors.



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**CORE COMPETENCIES**  
#GLIDERS, AUTONOMOUS UNINHABITED VEHICLES, #OCEANOLOGY, #CHANGING BUOYANCY SYSTEM

# MODELS, METHODS, PLATFORMS AND TECHNOLOGIES OF CROP PRODUCTION COORDINATED CONTROL



**Petr O. SKOBELEV**, Doctor of Technical Sciences, Head of Electronic Security Systems Department

**Denis S. BUDAEV**, Vice-Director of the Regional Scientific Center “Information Security”

**Georgiy Yu. VOSHCUK**, Software engineer of the Regional Scientific Center “Information Security”



**OBJECTIVES**

Wheat production of higher grades, support of agricultural producers in capturing a promising market, increasing efficiency of spending budgets at all levels, ecological restoration of soils for future generations, improving the quality of products and business efficiency, reducing control complexity, accelerating the transition to advanced technologies



**AREAS OF USE**

Agriculture, Ecology

**IMPLEMENTATION**

The project was implemented at the agricultural enterprises of Rostov and Samara Regions.



**PECULIARITIES**

The project combines advanced scientific and technological solutions in the field of crop production under control of innovative automated system.



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**CORE COMPETENCIES**

#INTELLIGENT SYSTEMS, #MULTI-AGENT TECHNOLOGIES, #REAL-TIME ECONOMY

# CONTACT ANALYSER OF HUMUS IN SOILS



**Vasiliy V. ERMAKOV**, Candidate of Technical Sciences, Head of the Laboratory in the Scientific and Analytical Center of Industrial Ecology

**Olga R. BARKOVA**, Head of the Department for Internships Organization and Assistance in Graduates Employment



**OBJECTIVES**  
Determination of humic acids and humates content in the soil cover in order to maintain the order of crop rotation and estimate the required quantities of applied fertilizers



**AREAS OF USE**  
Agriculture



Narrow spectral bands are used to obtain information on the humus content. As a source of radiation and sensitive elements, photo- and light-emitting diodes are used.



**PECULIARITIES**  
The project involves creation of a field analyzer for direct evaluation of soil fertility without additional laboratory analysis.



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**CORE COMPETENCIES**  
#SPECTROSCOPY, #ENVIRONMENTAL MONITORING, #SOIL FERTILITY, #HUMUS



# COLLECTIVE INTELLIGENCE OF ROBOT GROUPS



**Petr O. SKOBELEV**, Doctor of Technical Sciences, Head of Electronic Security Systems Department

**Alexander N. MOCHALKIN**, Director of the Regional Training and Scientific Center “Information Security”

**Denis S. BUDAEV**, Deputy Director of the Regional Training and Scientific Center “Information Security”

**Georgy Yu. VOSHCHUK**, Software Engineer of the Regional Training and Scientific Center “Information Security”



## OBJECTIVES

Solving tasks performed by groups of unmanned aerial vehicles (UAVs): reconnaissance and survey of the area, monitoring the condition and protection of industrial facilities, providing security at public events, participation in search and rescue, building digital models of terrain and three-dimensional models of buildings and different military tasks

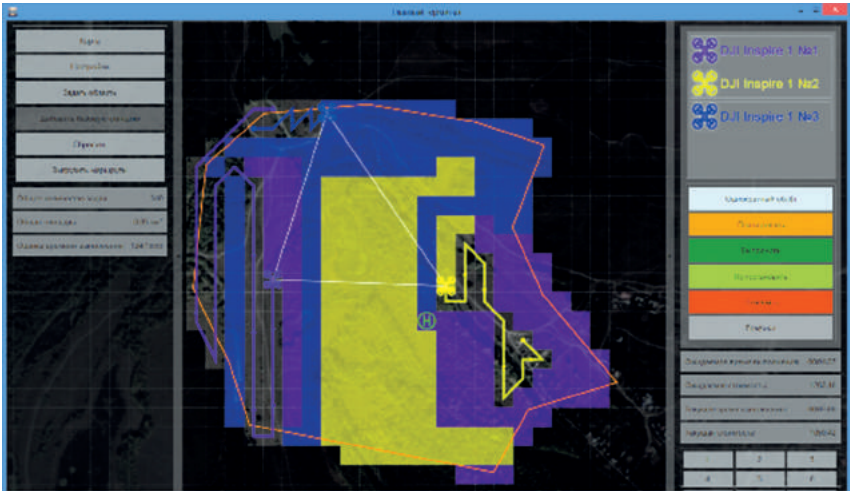


## AREAS OF USE

Military and Civil Industry (Dual-Use Technologies)

## IMPLEMENTATION

Since 2016, this system has been used as a part of a multi-agent precision farming system at an agricultural enterprise in the Rostov region. In 2017, it was tested as a part of the “Vikhr” robotic complex developed at the Main Research and Development Test Center of Robotics of the Ministry of Defense of the Russian Federation

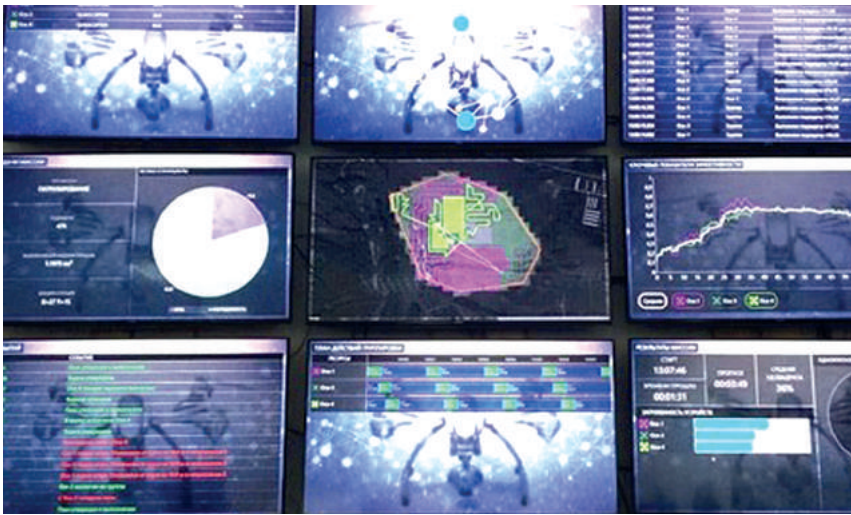


## LEGAL DEFENSE

Certificate of state registration of computer programs № 2016616174 - Multi-agent system for coordinated planning of flight tasks of jointly operating groups of unmanned aerial vehicles



The scientists plan to test new intellectual technologies and form an intelligent “system of systems” of the new generation based on the application of situational control elements, a network-centric approach, using the knowledge base about available information sources and multi-agent technologies.



**PECULIARITIES**

This project implements the concept of “swarm of swarms” - a community of intelligent interacting systems (systems of systems), which is built on the principles of the “smart” Internet of things.

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**CORE COMPETENCIES**

#INTELLIGENT TECHNOLOGIES, #NETWORK-CENTRIC SYSTEMS, #MULTI-AGENT TECHNOLOGIES, #UNMANNED AERIAL VEHICLES

# TECHNOLOGY OF DETONATION APPLICATION OF NANOSTRUCTURED COATINGS



**Maksim V. NENASHEV**, Doctor of Technical Sciences, Professor of “Technology of Solid Chemicals” Department

**Idar D. IBATULLIN**, Doctor of Technical Sciences, Professor of “Technology of Mechanical Engineering” Department

**Ilya V. NECHAEV**, Candidate of Technical Sciences, Associate Professor of “Technology of Solid Chemicals” Department

**Albert R. GALLYAMOV**, Candidate of Technical Sciences, Associate Professor of “Technology of Mechanical Engineering” Department



## OBJECTIVES

This technology is designed for Increasing tools lifespan, heavily loaded parts of components and mechanisms under the influence of abrasive media, high pressures and temperatures. This technology can be used to protect industrial equipment working in contact with molten rubber, plastics, glue, etc.

## LEGAL PROTECTION

Patent of the Russian Federation for invention N° 2542206 - Method of detonation coatings application

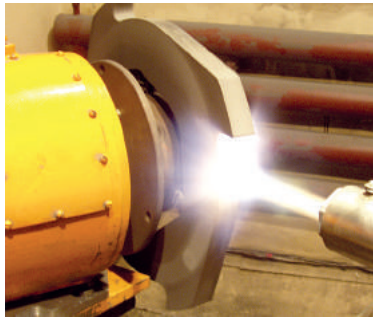


## AREAS OF USE

Mechanical Engineering, Radio Electronics, Electrical Engineering, Military Industry

## IMPLEMENTATION

The technology was used at JSC “Volgaburmash” for hardening cutters of three-roller and diamond drill bits.



The coating is applied by the detonation gun. During the process the gas stream warms up and partially melts the elements of the powder put into the barrel and throws them at high speed onto the surface of the workpiece installed in front of the gun barrel. When the elements collide with the surface a micro-welding occurs, and the powder is firmly attached to the workpiece at the molecular level. The required thickness of the coating is achieved by a series of successive shots. For machining large surfaces the part is moved in front of the barrel with the help of a manipulator according to the program.



## PECULIARITIES

This technology is supposed to be a breakthrough as the method for coating from a high-density powder material onto a metal workpiece.



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## CORE COMPETENCIES

#NANOSTRUCTURAL COATINGS, #DETONATION GUN

# INTEGRATED THERMO-OPTICAL AND MECHANICAL MODELING OF TELESCOPIC SYSTEMS AND DEVELOPMENT OF ACTIVE OPTICS TECHNOLOGY



**Yacov M. KLEBANOV**, Doctor of Technical Sciences, Head of the Mechanics Department



### OBJECTIVES

Increasing the resolution of telescopic systems, the use of active elements that systematically correct the aberrations of the wave front in telescopes



### AREAS OF USE

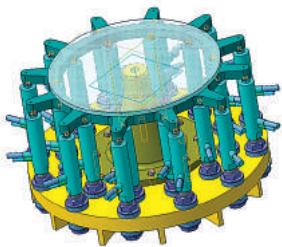
Aerospace Industry, Optics, Mechanical Engineering

### LEGAL DEFENSE

RF patent for the invention N° 2213185 - Method for compensating optical aberrations using a deformable mirror.  
USA Patent N° 9804388 - Method for compensating optical mirror with a deformable mirror

### IMPLEMENTATION

The project is operating at the JSC RC "Progress".



### PECULIARITIES

A new method of modal decomposition has been developed and on its basis a control system for active optics has been created, original procedures for integrated thermo-optical-modeling of telescopic systems are being carried out.



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### CORE COMPETENCIES

#ACTIVE OPTICS, #SPACE TELESCOPES, #THERMO-OPTICAL AND MECHANICAL MODELING, #METHOD OF MODAL DECOMPOSITION



# URBAN PLANNING REGULATION OF ARCHITECTURAL AND HISTORICAL ENVIRONMENT



**Tatyana V. VAVILONSKAYA,**  
Candidate of Architecture, Head  
of Department "Reconstruction  
and Restoration of Architectural  
Heritage"



## OBJECTIVES

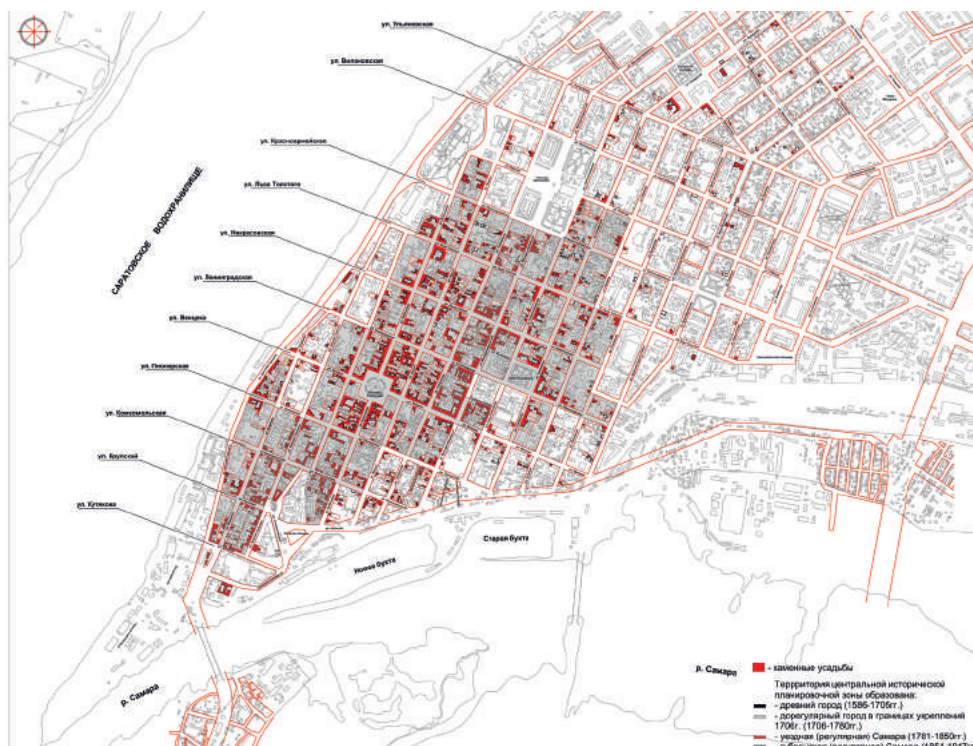
The implementation of a multi-level approach for a reasonable balance and interaction between the "old" and the "new" objects of architectural and historical environment

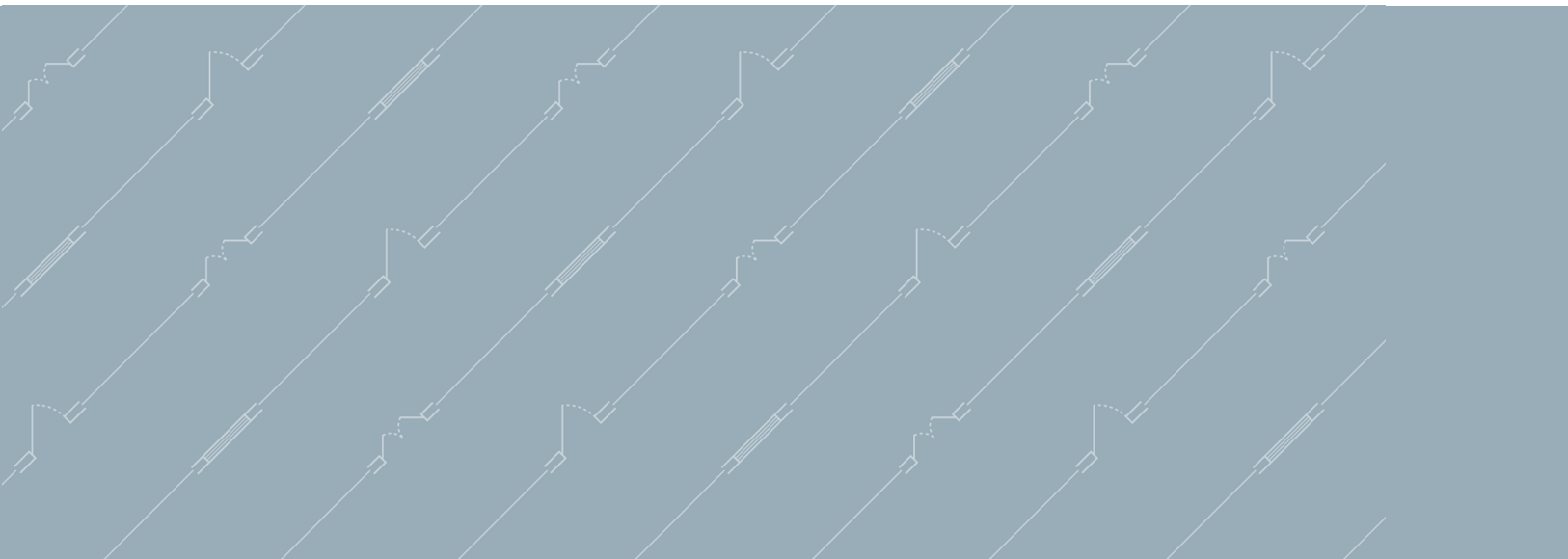


## AREAS OF USE

Civil Engineering, Architecture

The algorithm of urban planning regulation of architectural and historical environment takes into account the opposing tendencies expressed by the protection vector and renewal vector at different territorial planning levels i.e. "historical region", "historical city", "historical quarter".


































































PECULIARITIES

Within the framework this system of a multilevel approach to the study of the architectural and historical environment the data on recording and control of historical and cultural heritage heritage are systematized. Moreover, algorithms for evaluating, planning and regulating the architectural and historical environment at different spatial planning levels (a region, a city, a district), theoretical foundations and spatial planning principles of preservation and development of architectural and historical environment are created through systematic research strategic territorial and urban planning, as well as operational planning.

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КОНЦЕПЦИЯ ОХРАННОГО ЗОНИРОВАНИЯ

АРХИТЕКТУРНО-ИСТОРИЧЕСКАЯ СРЕДА						ПРЕДМЕТ ОХРАНЫ ИСТОРИЧЕСКОГО ПОСЕЛЕНИЯ
КРЕПОСТИ	АРХИТЕКТУРНОЕ НАСЛЕДИЕ			ОТДЕЛЬНЫЕ ПАМЯТНИКИ		
КУЛЬТУРНЫЙ ОПОЙ	РЕПРЕЗЕНТАТИВНАЯ ЗАСТРОЙКА			ОТДЕЛЬНЫЕ ФРАГМЕНТЫ СРЕДЫ		ГРАДОСТРОИТЕЛЬНАЯ ИСТОРИЯ
    	    			  	  	
ОБРАЗЦОВАЯ ЗАСТРОЙКА				СМЕШАННАЯ ЗАСТРОЙКА	ДЕРЕВЯННАЯ ЗАСТРОЙКА	
«ДРЕВНЯЯ САМАРА» I	II	«УЕЗДНАЯ САМАРА» III	IV «ГУБЕРНАСКАЯ САМАРА»	V «БЛИЖНИЙ ПРИГОРОД»	VI «ДАЛЬНИЙ ПРИГОРОД»	ПЕРИОДЫ РАЗВИТИЯ СРЕДЫ
   		    		  	  	
«ДОРЕГУЛЯРНАЯ САМАРА»						ГРАДОСТРОИТЕЛЬНОЕ ЗОНИРОВАНИЕ
ИСТОРИЧЕСКОЕ ЯДРО ЦЕНТРА				БЛИЖНЯЯ ПЕРИФЕРИЯ ЦЕНТРА	ДАЛЬНЯЯ ПЕРИФЕРИЯ ЦЕНТРА	
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ДМ	ОБЪЕДИНЕННЫЕ ЗОНЫ СТРОГОГО РЕГУЛИРОВАНИЯ ЗАСТРОЙКИ			ОБЪЕДИНЕННЫЕ ЗОНЫ РЕГУЛИРОВАНИЯ ЗАСТРОЙКИ		
   	    			  	  	РЕЖИМЫ РЕКОНСТРУКЦИИ
ФРАГМЕНТАРНАЯ РЕКОНСТРУКЦИЯ				ЧАСТИЧНАЯ РЕКОНСТРУКЦИЯ	ТОТАЛЬНАЯ РЕКОНСТРУКЦИЯ	
						ВЫСОТНЫЕ РЕГЛАМЕНТЫ (эт.)
3	3	3	4	6	8	
4	4	5	6	8	10	По красной линии
4	6	6	7	10	14	Внутри квартала
						Доминанты

CORE COMPETENCIES

#RESTORATION, #OBJECTS OF CULTURAL HERITAGE, #RECONSTRUCTION, #URBAN PLANNING, #TERRITORIAL PLANNING

# TECHNOLOGIES FOR PRODUCING FUNCTIONAL FOOD PRODUCTS ON THE BASIS OF PLANT RAW MATERIALS WITH HIGH ANTIOXIDANT ACTIVITY INDICATORS



**Vladimir V. BAKHAREV**, Doctor of Chemistry, Dean of the Faculty of Food Production

**Nadezhda MAKAROVA**, Doctor of Chemistry, Head of Technology and Organization of Public Catering Department



**OBJECTIVES**

Prevention of various diseases, as well as everyday use in extreme conditions: in space, in the Arctic and Antarctic, on offshore oil platforms, in the mountains, on submarines.



**AREAS OF USE**

Food Industry, Food for Geologists, Astronauts, Military



A number of plants with good prospects that grow in the Samara region and possess antioxidant activity have been identified in the course of the research. Technologies have been developed for obtaining extracts enriched with components responsible for the appearance of the antioxidant effect, and studies have begun on the anticarcinogenic effect of these extracts. Formulations and technologies for the production of functional foods enriched with high antioxidant indicators components are being developed.



**PECULIARITIES**

The project stipulates a prophylactic model for reducing the number of various diseases due to the introduction of components of plant materials with high antioxidant indicators into the nutritional scheme of the Samara region population.



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**CORE COMPETENCIES**

#ANTIOXIDANTS, #FUNCTIONAL FOOD PRODUCTS, #PLANT RAW MATERIALS

# TECHNOLOGY OF EDIBLE FILMS AND PACKAGING



**Nadezhda V. MAKAROVA**, Doctor of Chemical Sciences, Head of Department “Food Services Technologies and Organization”



### OBJECTIVES

Use under the conditions where the cost of food transporting is extremely high: during space expeditions, during Arctic and Antarctic expeditions, at offshore oil platforms, during mountain expeditions, in long submarine voyages etc.



### AREAS OF USE

Food Production, Food Services, Nutrition for Geologists, Cosmonauts, Military

Edible films have a number of undoubted advantages. First of all, they relate to biodegradable materials that do not create any additional environmental load. What is more, such package is safe for human health. Moreover, it has water vapor, gases, flavoring substances barrier properties. And last but not least, it improves the quality of food products and increases their expiry date. According to the recipes and technologies, more than 400 samples of edible film on the basis of fruit and vegetable raw materials were obtained.



### PECULIARITIES

This project expands knowledge of theoretical foundations for recipes and technologies for edible films production.



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### CORE COMPETENCIES

#EDIBLE FILMS, #ANTIOXIDANTS, #PLASTIFICATORS AND HYDROPHOBIC ADDITIVES, #VEGETABLE RAW MATERIALS



# EXPERIMENTAL-INDUSTRIAL COMPLEX OF WASTE AND RESIDUES NEUTRALIZATION OF NATURAL GAS ODORANT



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## OBJECTIVES

Neutralization (reduction of hazard class) of decommissioned odorant storage tanks and prevention of contamination with odorant waste from soil, water and air basins.



## AREAS OF USE

Oil and Gas Industry, Industrial Ecology

## LEGAL PROTECTION

Patent of the Russian Federation N° 2537593 - Method of tanks cleaning

## IMPLEMENTATION

The project has undergone comprehensive industrial tests at "Gazprom Transgaz Samara" venues.

This project involves the installation of a mobile pilot industrial complex for waste and residues neutralization of natural gas odorant. The equipment is installed on the basis of a standard sea container with transportation possibility. The impact of the complex on the environment at all stages of the life cycle was assessed. The approval of the State Ecological Expertise was received. The conducted studies of the residual toxicity of neutralized odorant storage tanks have proved their attribution to the V class of hazard for the environment. This project allows to solve the problem of accumulation of odorant waste and to prevent contamination of soil, water and air basins. The economic effect of this development is evaluated as than 35 000 rubles per year.



## PECULIARITIES

The complex has no analogues in the world.



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## CORE COMPETENCIES

#NATURAL GAS ODORANT, #INDUSTRIAL ECOLOGY, #TANKS AND CONTAINERS, #ENVIRONMENTAL CONTAMINATION