SCIENCE & TECHNOLOGY
CENTER IN UKRAINE

**AN INTERGOVERNMENTAL ORGANIZATION
ASSISTING FORMER WEAPONS SCIENTISTS'
TRANSITION TO PEACEFUL PROFITABLE
CONTRIBUTIONS TO GLOBAL R&D**

International R&D Partnerships

Gateway to the Hi-Tech World of Former WMD Scientists

Business Security, Reliability and Stability

Over Ten Years of Successful Operations

Azerbaijan | Canada | European Union | Georgia | Moldova | Ukraine | USA | Uzbekistan

The Science & Technology Center in Ukraine (STCU) provides Western companies with the services of highly skilled scientists from Azerbaijan, Georgia, Moldova, Ukraine and Uzbekistan as well as tax-free privileges, duty-free import of equipment and Western-style project monitoring. The STCU is an intergovernmental organization dedicated to the non-proliferation of weapons of mass destruction expertise. Since 1993, private companies and government agencies from Canada, the European Union and the United States have used the STCU to manage over 800 R&D projects, worth nearly $120 million.

Background images courtesy of Accelrys, www.accelrys.com

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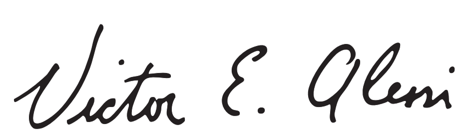
Welcome from the Chairman of the STCU Governing Board

Victor ALESSI
Chairman of the STCU Governing Board

Nine years have elapsed since the Science and Technology Center in Ukraine held its first governing board meeting in December 1995. Since that time, the Center has sponsored research amounting to nearly US $120 million, supporting thousands of former weapons of mass destruction and other scientists. This research, which continued successfully during the past year, has encompassed the wide sweep of the scientific and technological development so necessary to ensure our future, including environmental monitoring, alternative energy development, medicine and biotechnology, sensors and measuring systems, information technologies, materials science, coatings, basic sciences and many other areas. The year 2004 also saw the STCU continue to expand its reach in the countries of the former Soviet Union, opening its Regional Office in Azerbaijan, as well as welcoming the accession of Moldova to the organization at the end of the year.

The STCU, being a unique example of effective multilateral cooperation, is strategically positioned to be a balanced, effective tool of the Parties for contributing to the conversion of industrial-technical potential from military to peaceful endeavors, and to the fulfillment of the people's aspirations for a stable, modern market economy. The organization is dynamic, pro-active and looking to the future. As it continues to develop innovative approaches to technology and science, and helps former weapons scientists cooperate with Western scientists as well as conduct business in the West, the promise of the STCU comes ever closer to fulfillment.



Welcome from the STCU Executive Director

Andrew A. HOOD
STCU Executive Director

The STCU is ideally positioned to match an unexploited supply of scientific and technical expertise to meet your commercial or non-commercial needs. Through its primary mission of nonproliferation of WMD expertise, the STCU has compiled a treasure trove of experience and knowledge about the many highly talented scientists and technologists in Azerbaijan, Georgia, Moldova, Ukraine and Uzbekistan. And the STCU is a well-established, western-style organization with nearly 10 years of operational experience that can help steer you through the uncertainties of the business and investment environments in these emerging economies. The STCU has:

- Legal status, diplomatic accreditation, tax- and customs exemptions for financed projects and activities, all guaranteed under the international agreement establishing the STCU;
- Proven experience in project management: over 850 research projects totaling almost $120 million, performed in close collaboration with the European and North American scientific communities;
- Over 80 private sector and governmental agencies which have joined the STCU's Partnership Program to finance their own, tailored S&T projects (totaling nearly $30 million) through the STCU.

The STCU's staff of professionals is experienced in working with industry and business representatives, including protecting their business-sensitive information and interests. In this way, the STCU can serve you as a trustworthy and cost-effective bridge to the yet-to-be-tapped opportunities for contract research and technology development in Azerbaijan, Georgia, Moldova, Ukraine and Uzbekistan.

I hope that you will find the STCU worthy of a closer look. It is a win-win-win situation you should not pass up: win for you, win for these former military institutes looking for a chance to perform, and win for the STCU's nonproliferation mission (which, actually, is a win for global security)!

The New Structure of the STCU

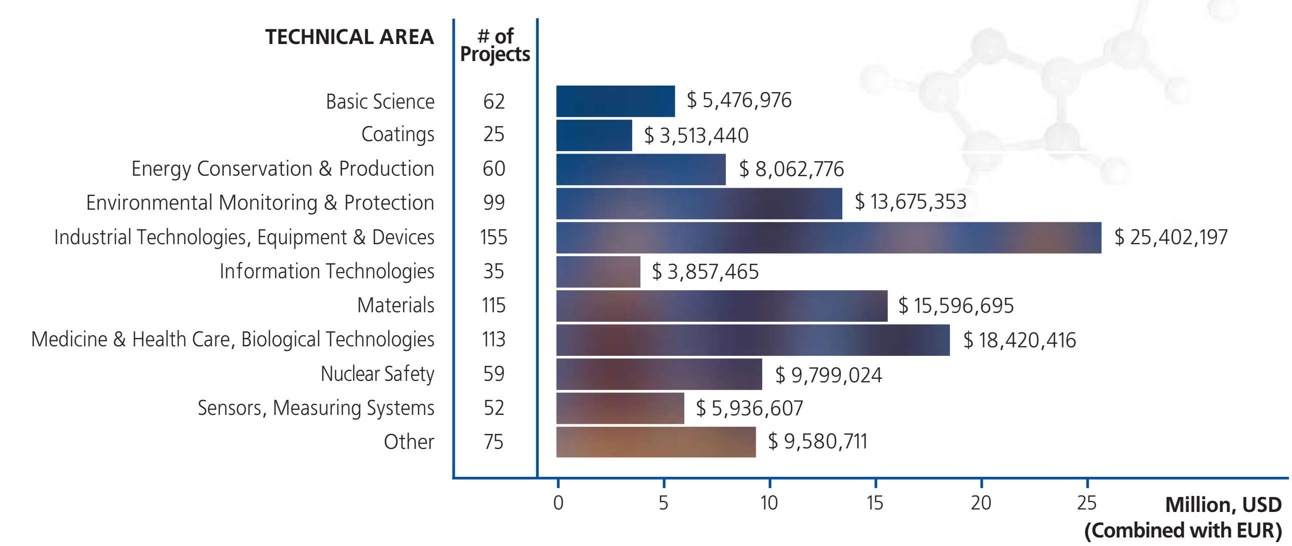
- **STCU Executive Director** (Andrew Hood, USA)
  - **Chief Financial Officer** (Curtis Bjelajac, USA)
  - **Chief Administrative Officer** (David Cleave, EU)
  - **Deputy Executive Director Science Excellence** (Esa Manninen, EU)
    1. Project Management: Nuclear Safety & Energy, Environment, Basic Sciences, Materials, Non-Nuclear Energy
    2. Proposal Processing
    3. Workshops/Seminars: Science Promotion, Competitive Research Support
    4. Regional Offices: Georgia, Moldova
  - **Deputy Executive Director Technology Advancement** (Landis Henry, Canada)
    1. Project Management: Biotechnology & Public Health, Industrial Technology & Safety, Instrumentation & Sensors, Information Technology
    2. Targeted R&D Initiatives
    3. Regional Offices: Dnipropetrovsk, Kharkiv, Lviv
  - **Deputy Executive Director Sustainability Promotion** (John Zimmerman, USA)
    1. Project Management: Partner Recruitment, Promotional Missions, Contacts/Networking Support
    2. Market Analysis
    3. Sustainability Development: Targeted Matchmaking, Institute Strategic Planning Support
    4. Patent/IPR Support
    5. Regional Offices: Azerbaijan, Uzbekistan
  - **Principal Deputy Executive Director Performance/Public Outreach** (Borys Atamanenko, Ukraine)
    1. Public Outreach: Promotional & Support Materials, Conference Support, Travel Grants
    2. Performance Measuring: Self-Sustainability, Program Effectiveness
    3. Targeted Training Program

The STCU's Matchmaking Initiative

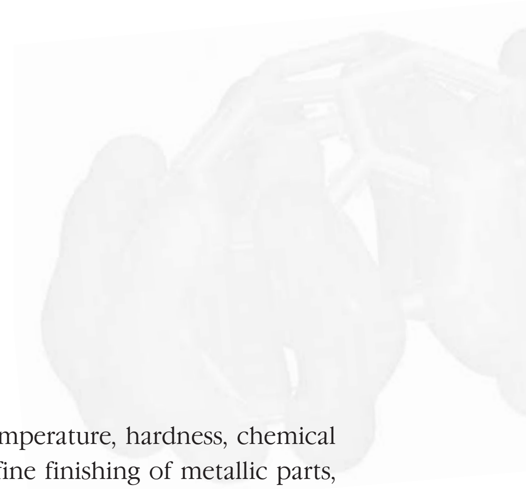
The goal of the Matchmaking initiative is to provide opportunities for information exchange, as well as matchmaking, between scientists and industries about their R&D potential and needs. Nanotechnology, an interdisciplinary field that includes the fields of physics, chemistry, applied sciences, engineering, biology and biomedical technology, is addressed in a number of proposals registered with the STCU along with over thirty STCU-funded projects. The number of knowledgeable researchers and trained personnel in this field; technologies for collaborative development, licensing, cooperative marketing and commercialization are accessible through the STCU.

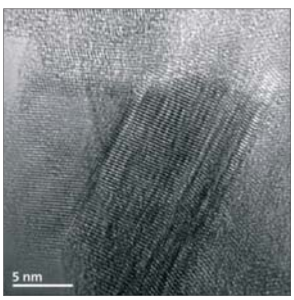
We kindly ask interested technology end-users (private firms, governmental bodies, educational institutions, etc.) to contact the STCU Governmental Partnerships Program (lyubov.taranenko@stcu.int) and Non-governmental Partnerships Program (boris.komarov@stcu.int) for assistance in matching your technology needs to the supply of excellent, knowledgeable expertise in Azerbaijan, Georgia, Moldova, Ukraine and Uzbekistan.

PROJECT FUNDING BY PRIMARY TECHNICAL AREA, 1996–2004



Ceramic Nanocomposites

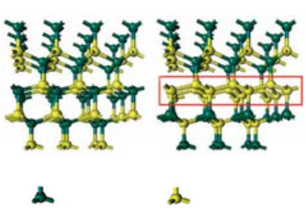




HRTEM of the SiC-C solid solution

STRUCTURE MODELS

Silicon carbide (SiC)   Solid solution SiC-C (Diamond)



Silicon   Carbon

Ceramic nanocomposites which have a high melting temperature, hardness, chemical and thermal stability applicable for cutting tools, extra-fine finishing of metallic parts, wear resistive components, radiators for electronics, radiation resistive ceramic components.

SiC-C based nanocomposites are nanocrystalline (40-120 nm) beta-silicon carbide reinforced with diamond planar clusters built-in the lattice of SiC with the following properties:

- hardness around 40 GPa in pure poreless form and 24GPa in nanocompostes with alumina;
- fracture toughness around 9 MPa $m^{1/2}$.

Equipped pilot shop for production of SiC-C nanopowder is available.

Developed materials were tested by Baker Hughes INTEQ GmbH.

Si_3N_4-TiN-TiB_2 based nanocomposites are nano-TiN reinforced with nano-TiB_2 and Si_3N_4 particles with the following properties:

- hardness around 20 GPs;
- fracture toughness of up to 8.5 MPa $m^{1/2}$;
- maintain high stability (grain size around 80 nm) of up to 800^{0}C .

Developed materials were tested by the ALCON Concern, Ukraine.

Prof. Andrey V. Ragulya, Institute for Problems in Material Science, Kyiv

Oxide Nanopowders for Manufacturing Ceramics

Oxide nanopowders with a tailored particle size, chemical, phase, and granulometric composition for manufacturing ceramics, producing materials for nanoelectronics, as well as creating nanocomposites and nano-porous materials.

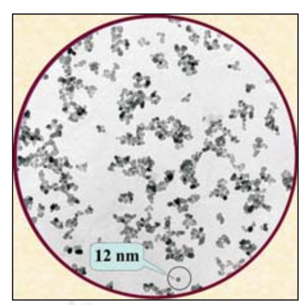
Production technology has been developed for ZrO_2 powders and is being tested for TiO_2, $(La,Sr)MnO_3$, $LaBGeO_5$, Al_2O_3-MgO, and other powders.

The technology is based on chemical methods combined with highly effective physical impacts — ultrasound, MWR radiation, pulse magnetic field, high hydrostatic pressure and heat treatment.

The technology provides for:

- narrow particle size distribution;
- low degree of agglomeration;
- predetermined particle sizes in the range of 5 to 50 nm;
- homogenious component distribution;
- low synthesis temperature (400-500^{o}C);
- eliminating the mechanical grinding stage;
- high performance of ceramics and polymer matrix nanocomposites including homogeneity, stability and durability;
- production of precise articles and films;
- low cost, environmentally friendly.

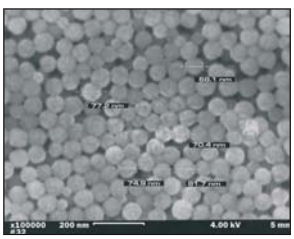
Pilot line for nanopowder manufacture. Chemical zone



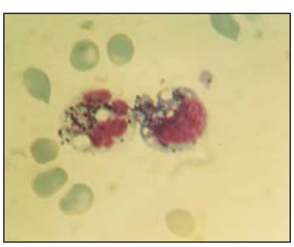
Zirconium Dioxide nanopowder

Prof. Tatjana E. Konstantinova, Donetsk Physics and Technology Institute, Donetsk

Polymeric, Inorganic, and Colloidal Nanoparticles



SEM of polyStr latex obtained in the presence of oligoperoxide metal complexes (OMC) which act as an initiator-stabilizer



The absorption of Ni colloids opsonizated by protein concanavaline A, by neutrophile human blood cells. Two neutrophile cells, which are tightly packed up by colloids are shown in the picture

Surface-active oligoperoxides and oligoperoxide metal complexes have been developed and are being utilized for the production of the following functional nanoparticles:

- Polymeric nanoparticles including fluorocontaining ones (40-100 nm), i.e. polystyrene and polyacrylate, with tailored particle size distribution, functionality and reactivity;
- Reactive functional nanoparticles with magnetic, conductive, resistive and dielectrical properties: ferric oxide based nanoparticles (8-12 nm), Ag (10-20 nm), Cu (500 nm), Ni (1-2 micrometres);
- Biocompatible colloidal particles capable of binding proteins and interaction with cell membrane, which are based on polymeric, ferric oxide, and Ni nanoparticles;
- Water-soluble oligomeric surfactants capable of improving the solubility of drugs and water based preparations;
- Luminescent oligomeric and colloidal cell markers.

Available production processes include, but are not limited to, radical polymerization and homogenous nucleation. Developed oligoperoxides and oligoperoxide metal complexes are of linear, block- and highly branched structures (including fluorocontaining chains or branches).

Applications in microelectronics, biotechnology, surface modification in particular (water repellents, antimicrobial coatings, fillers, fibers and fabrics).

Prof. Alexander S. Zaichenko, Lviv Polytechnic National University, Lviv

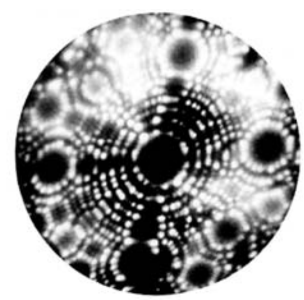
High-Field Nanoprocessing for Smoothing Metal Surfaces at the Atomic Level

Developed nanotechnology for treatment of nano-scaled objects, including curved objects, provides for surface modification into an atomically smooth state (surface with zero roughness) and is applicable for production of:

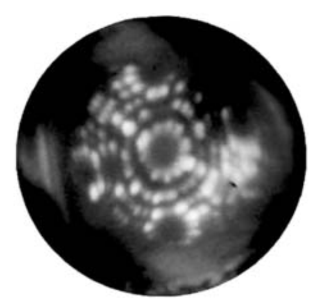
- ultra-sharp atraumatic ophthalmologic microsurgical instruments;
- ultra-fine microprobes for high-resolution scanning tunneling microscopes and for nanotechnological devices based on such microscopes;
- field emitters with localized emission surface for nanoelectronics.

The technology is based on the discovered phenomenon of evaporation of metals in high electric fields in the presence of dielectric liquids at low temperatures. The previously known method, which was based on evaporation in super-high electric fields, faced a serious technological problem caused by the destruction of objects under the impact of mechanical stress generated by super-high electric fields. The developed method resolves this problem.

Joint patents with Dr. N. Wanderka, Hahn-Meitner-Institute, Berlin, Germany, and Dr. R. Forbes, University of Surrey School of Electronics, UK.



a

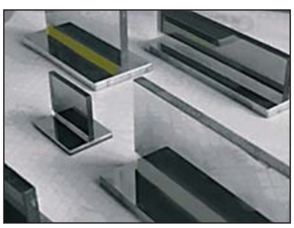


b

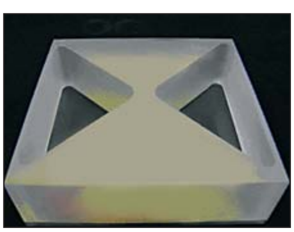
Field ion microscopic images of STM probe before **(a)** and after **(b)** high-field processing

Prof. Igor M. Mikhailovskij, Kharkiv Institute of Physics and Technology, Kharkiv

Glue–Free Bonding of Glass Ceramics Using Nanolayers



Samples of a mirror prism with external reflection and 90° angle



Sample of a light-weight mirror fragment

Developed technology of Solid-Phase Bonding of Polished Parts (SBPP) joins parts that are made of Zerodur glass ceramics and provides for:

- the accuracy of a joined optical construction (angular positions) is close (within 1 angular second) to the accuracy of high-precision components manufacturing;
- the accuracy of a joined optical construction is stable under temperature changes (+400°C to -196°C) and mechanical double impact (by 100 g followed by 300 g);
- durability and stability of joined optical constructions remain at the monolith level;
- the size of parts that can be joined is extremely high, up to 8 m.

In SBPP, connective nanolayers include silicon oxide based substance and different metals oxides in combination with aluminum. The layers are vacuum deposited.

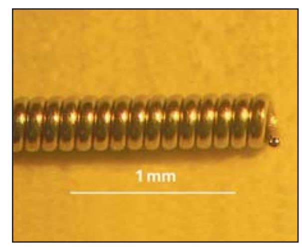
Applications in serial optical manufacturing (laser gyroscope, light-weight mirrors, mirror prisms, etc.).

Collaboration with Schott AG, Germany, exclusive producer of Zerodur.

Dr. Vladimir Maslov, Institute of Semiconductor Physics, Kyiv

Nanostuctural Materials for Medical Applications

- Ultra-fine-grained tantalum, stainless steel replacement, in production of stents for cardiovascular surgery.
- Microsources and thin-walled shells for radioactive microsources applicable in angioplasty.
- Unique nanotitanium and yttrium β-sources for medical treatment of restenosis by the means of endovascular therapy of coronary vessels.
- Nanotitanium needles and applicators for radio-therapy of cancer in prostate, uterus and breasts.
- Biosoluble magnesium for endoprostheseses applicable in cardiology and bone surgery.



Medical radioactive β-source on the base of Ce-144

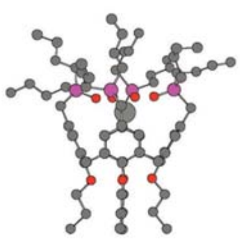
These products are based on the developed methods of simultaneous application of intensive plastic deformation and programmed thermal treatment that results in the formation of ultra fine-grained structures (d < 0,5 μm) and improved strength (by 1.5 times) and plasticity (by 2 to 4 times).

Three international patents.

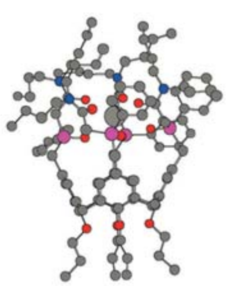
Prof. Igor I. Papirov, Kharkiv Institute of Physics and Technology, Kharkiv

Phosphorus-Containing Calixarenes

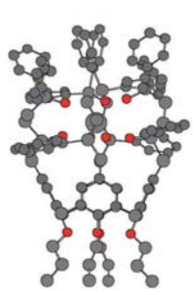
CALIXARENE — METAL CATION COMPLEXES



Calix-Phosphine Oxide



Calix-CMPO



Calix-Diphosphine Dioxide

In over ten years of expertise in phosphorus-containing calixarenes chemistry, the team synthesized over 250 new calixarenes; more than twenty of which are now commercially available worldwide through the Acros Organics Company.

The kilo-scale setup for calixarenes manufacturing is owned and operated by the team.

Calixarene based Electronic Nose was developed for monitoring hazardous pollutants in the environment; quality control in the food industry, automotive paintwork (control of organic solvent in air), agriculture, perfumes and beverages production; detection of drugs and explosives in customer service.

Applications in nanomedicine (drug delivery systems, diagnostics, scaffolds for drug design), nanotechnology, chemistry, material science including highly selective extractants, supramolecular catalysts, nanoparticles, nanocomposites, sensors and bioactive compounds.

Calixarenes, macrocyclic compounds capable of assuming a basket (or 'calix') shaped conformation, due to such architecture are capable of recognizing, binding and separating anions, cations, neutral organic molecules (up to optical antipodes) and bio-molecules, which are similar in properties and, in so doing, are hardly recognized by other means. This stipulates a wide diversity of applications for calixarenes.

Prof. Vitaly I. Kalchenko, Institute of Organic Chemistry, Kyiv

Hybrid Nanocomposites

Hybrid Nanocomposites for Lithium Battery Cathodes

Hybrid nanocomposites

Developed ternary hybrid nanocomposites have a guest-host structure and include:

- inorganic nanoparticles i.e. layered vanadium oxide particles of around 10nm in size;
- electron-conducting polymer (polyaniline, polypyrrole), the macromolecules of which are mainly located inside the inorganic nanoparticles;
- ion-conducting polymer (poly(ethylene oxide)), whose chains are located both inside and outside of the inorganic nanoparticles.

The simultaneous presence of both electron-conducting and ion-conducting polymers inside the inorganic nanoparticles, in the form of a layer (0.5–0.6 nm thick), is a distinctive feature in comparison with known hybrids and provides for improved efficiency of charge-discharge cycling.

Can be used as an active component of the cathode in lithium batteries. Targeted discharge capacity is 200-250 mA•h/g which considerably exceeds the characteristics of presently used cathode materials.

Hybrid Nanocomposites for Light-Emitting Diodes

Hybrid nanocomposites based on organic semiconductors and inorganic matrices that are applicable in light-emitting diodes and displays.

Semiconducting conjugated polymer (MEH-PPV) and inorganic mesoporous silica (MCM-41) were used as the basis for the developed nanocomposite. The content of the organic component in the developed nanocomposite is 15wt% which well exceeds known international prototypes. Organic macromolecules are confined inside the channels of the mesoporous inorganic matrix that results in improved efficiency of electroluminescence and environmental stability.

Dr. Oleg Y. Posudievsky, Institute of Physical Chemistry, Kyiv

Hard–Melting Composite Coatings on Light–Melting Metals

Developed technology of plasma electrolytic oxidation makes use of the electrolysis driven by direct/alternative/pulse current and electrical breakdown voltage. Surface microplasma discharge promotes the crystallization of amorphous oxide film. Thus, the bulk of the underlying metal remains unheated and undistorted. This technology is of special importance for lightweight metals and alloys having numerous applications in the aircraft industry, mechanical engineering and instrumentation.

A new class of composite coatings results from this technology providing for:

- thickness variables from 20 to 300 mm;
- hardness of up to 25 GPa;
- variable coating coloration;
- high hardness, excellent adhesion, corrosion resistance, wear and friction performances, which are superior to both hard anodic films and plasma sprayed ceramics.

Cleaning, etching and polishing of surfaces can be also performed by the developed process.

The technology is inexpensive and ecologically friendly.

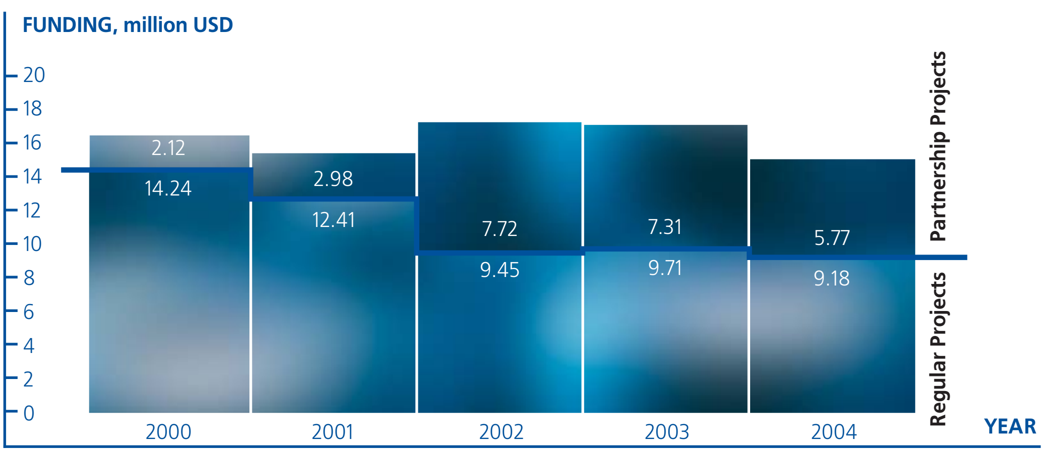
Tribological applications, anticorrosion coatings, implants, electronic components.

6 national patents.

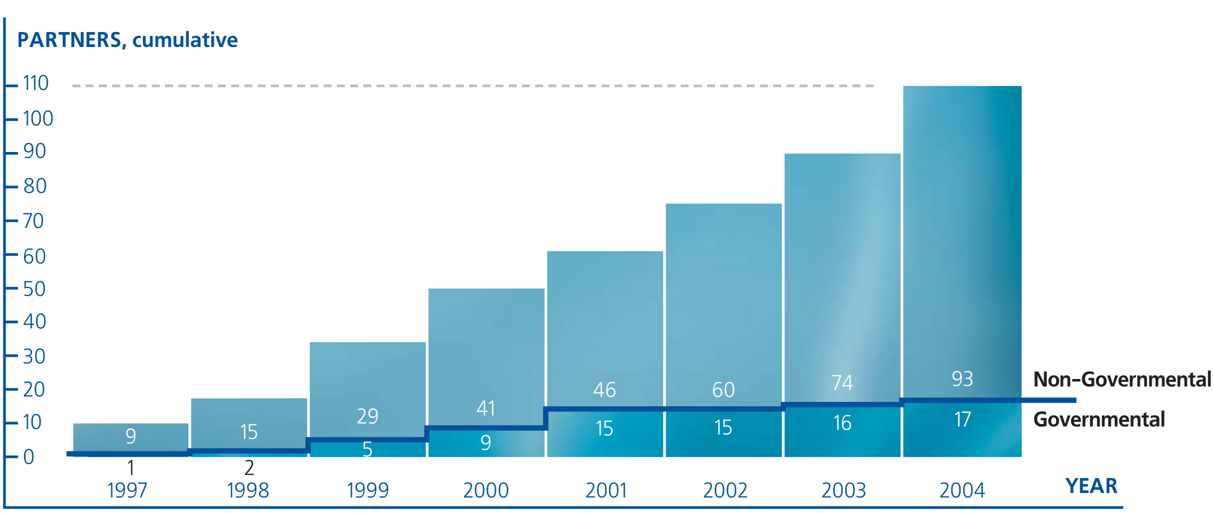
Dr. Lyubov Snizhko, University for Chemical Engineering, Dnipropetrovsk

STCU Financial Activity

STCU PROJECT ACTIVITY, 2000–2004



STCU PARTNERS, 1997–2004



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STCU–funded projects cover a wide range of disciplines, including over thirty on–going nanotechnology projects. For forward–looking nanotech organizations, the STCU offers a great opportunity to examine the many products and services available at our member institutes.