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February, 2012

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MESSAGE FROM NEIL B. GODICK

The average bribe in Russia surged 3.5 times in 2011 in comparison to 2010. Many see the government's anti-corruption efforts as half-hearted at best.

"The average bribe paid to a government official grew more than 3.5 times to almost $8,000," the Interior Ministry reported. The amount of damage compensation for crimes committed went up more than 50% to roughly R4.5bn, the official added.

In May 2011, Russia adopted a controversial system of fining bribe-takers up to 100 times the bribe they have taken instead of jailing them. According to a Russian news agency, the largest fine to be imposed is $10m.

Critics complain that government anti-corruption efforts generally focus on small fry rather than the big fish in top government positions. Sergei Ivanov, newly appointed head of the presidential administration, chairing a meeting of the Presidential Anti-Corruption Council January 26, claimed the most corrupt sectors to be health, education and housing.

He cited data from the Investigations Committee, according to which corruption-related indictments against 255 elected heads of municipal districts and 253 employees of municipal establishments and enterprises were sent to court in 2011.

In the same period, 1,990 criminal cases were launched against healthcare and welfare employees. Approximately 2,000 criminal cases were launched in education and science and 302 cases against employees of the housing and utilities.

Interestingly, it should be noted that Russia has failed to sign the 20th article of the United Nation's Anti-Corruption Convention, concerning the combating of illegal enrichment.

We do not intend for the following reports to solve any need our readers may have. We do intend to keep everyone current on technology developments in Russia. If you would like any additional *information on any of the developments reported – send us a note.*

Technology for developing new radiation-modified semiconductor materials

Russian researchers have developed a technology to produce radiation-modified semiconductor materials: Si, AIII-BV-type compounds, and GaN-based epitaxial films that are the basis for developing high-performance nanostructures. The radiation modification method produces semiconductor materials with unique properties that are unattainable using traditional metallurgical techniques.

The radiation-modified materials' basic advantage is high dopant impurity uniformity within the material. This results in materials with highly uniform electrophysical properties. Materials made using traditional growing methods have a property distribution heterogeneity within the material of 7-15%. The radiation-modified semiconductors' heterogeneity is 3-5%. This is the reason there is still no alternative to radiation-modified Si for manufacturing power semiconductor devices. The radiation-modified GaAs optical absorption coefficient at λ=10.6 µm, (5-6)•$10^{-3}cm^{-1}$ is two times lower than that of GaAs obtained by traditional growing methods – (1.2)•$10^{-2}cm^{-1}$.

Another advantage is: for the radiation-modified materials, there is no limit for dopant concentration. Dopant concentration is determined only by the nuclear-physical properties of source materials and irradiation time in the nuclear reactor. The materials, after passing an irradiation cycle and high-temperature processing, have 10 times higher radiation resistance. For these materials the limiting neutron fluence at change of characteristics by more than 30%, $10^{16}cm^{-2}$ compared to traditional materials ($10^{15}cm^{-2}$).

Applying nuclear-doped and radiation-modified materials as substrates and working structures considerably enhances the semiconductor devices' quality and reliability. It was experimentally established in solar cell manufacturing that the quality yield from a nuclear-doped GaAs plate increased tens of times.
#2012-01-210

High-porosity composite elastic osteoinductive coating for intramedullary implants

Orthopedic pathology methods and therapy techniques based on bone and perosseous osteosynthesis using external fixation devices of (EFD) sometimes reach their biomechanical potential limit. When they reach this limit they cannot be effectively used for those diagnosed with imperfect osteogenesis, phosphate diabetes or Ollier disease. To provide effective therapy for complex and multifactorial locomotor apparatus pathologies, especially during cancers, a new method was created for active action on bone tissue and managing its regeneration and mineralization processes. This concept is *strained intramedullary reinforcement* or *elastic intrabone osteosynthesis*. **The Russian scientists developed a method that forms a biocoating with various surface characteristics.** Forming the coatings utilizes polymeric composites from a two-phase material:

- an organic phase that is a biologically inert polymer binder with elasticity, adhesivity relative to materials used together with it, biological inertness, and resistance to sterilization;
- inorganic phase that is a biologically active filler, for example, from finely dispersible hydroxyl apatite powder.

The coating's surface porosity is a multilevel structured system consisting of both micro and macro-pores. The greatest contribution to porosity is made by pores sized up to 5,000 μm^2. These pores promote bone tissue ingrowth into the composite's pores.

The biocoatings are sterilized using ethylene oxide; they are nontoxic, apyrogenic, and sterile. In vivo tests did not reveal any negative tissue reactions to the implanted material. The ectopic formation test shows a positive implantation results.
#2012-01-211

A new aluminum oxide production method

Researchers from the Moscow State Institute of Electronic Engineering developed new method to make nanoporous aluminum oxide. The new technique can be used to produce a wide variety of state of the art materials for semiconductor devices (e.g., photon crystals). Now methods based on the self-organization and self-formation materials are being actively developed.

One of these methods is semiconductor nanoprofiling by plasma etching using a solid porous anode aluminum oxide mask. To optimize this process, a metal sublayer, e.g., a thin titanium film, is introduced into the aluminum oxide mask structure. To this point the problem was the lack of *data allowing selection of the optimum design for a two-layer solid mask and to control the semiconductor nanoprofiling process using it.*

To solve this problem, the scientists studied the process used to form this solid porous aluminum oxide mask for silicon nanoprofiling. They determined the optimum anodizing time for producing an effective solid mask from porous aluminum oxide, and identified the optimum thickness for the auxiliary titanium sublayer. They also determined that, during plasma etching of silicon through an aluminum oxide mask, the lateral dimensions for dents in the silicon depend on the aluminum oxide pore aspect ratio. In the course of their studies they achieved conditions at which silicon substrate nanoprofiling a makes the dents precisely reproduce the solid aluminum oxide mask pore pattern.
#2012-01-212

Super-reliable Li-Ion batteries from archaea

Scientists from the Institute of Protein Research, RAS at Pushchino and the Institute of Physical Chemistry and Electrochemistry, RAS in Moscow developed lithium-ion batteries with electrodes made from flagella of halophilic (i.e.

living in waters with very high salt concentrations) archaea.

Today most mobile electronic devices use lithium-ion batteries whose capacity and durability still fail to meet consumers' ever expanding requirements. In 2006 biotechnologists from Massachusetts Institute of Technology found a way to use genetically modified viral particles to manufacture batteries. Using nanowires from viral particles as the base for electrodes considerably slowed down the electrodes' degradation. The Moscow researchers proved that archaeal flagella are much more suitable for solving this problem than ordinary bacteria flagella. Many archaea are extremophilic by nature (i.e. they occupy habitats that are actually unsuitable for other species' survival). Within batteries, where physical conditions are far from habitual for living organisms and close to extreme, archaeal proteins can survive and serve as reliable structural elements.

The Russian scientists genetically modified the flagella so that they have four additional aspartic acid residues. These residues in proteins have a negative electric charge. Therefore positively charged cobalt ions can be easily attached to them. This is necessary to ensure correct electrochemical processes within the accumulator. Batteries produced in this way proved to be more capacious and durable.

#2012-01-213

Introducing nickel into silicon

Scientists from four Russian institutes investigated the optical properties of silicon dioxide substrate modified by nickel nanoparticles. Their results show that nickel concentration substantially affects the material's optical properties. This discovery could be useful for developing high-speed optical devices. Using light instead of electrons offers obvious advantages: photonic microcircuitry considerably increases speed and processed data volumes, and decreases waste heat from computers.

Practical application of these new materials in photonics requires minimizing their production cost and ability to control the materials' optical properties. It is known that magnetic fields can be used to change a material's optical properties. The Russian researchers suggested using a composite with nickel nanoparticles as the material with high magneto-optic properties. A silicon oxide substrate served as the composite matrix. The researchers bombarded this substrate with nickel ions. As a result, metal nanoparticles sized 2 to 16 nm were formed at a depth of 10-15nm.

The scientists concluded that, unlike ordinary nickel film, surface plasmons are responsible for changing the composite's optical properties. These fluctuations possess their own frequency, which plays an essential role in metals' optical properties. Light with a frequency below plasmonic frequency will be reflected, while light with frequencies above it will penetrate the solid body. By changing the nickel concentration in the silicon dioxide, it is possible to control these changes and to develop new materials for optical computing machinery.

Economically, the method looks quite attractive. The silicon oxide substrate production technique and the ionic metal implantation into the substrate are proven technologies in electronic microcircuit manufacturing.
#2012-01-214

Nonequilibrium aluminum-based nano-alloys with the function of "metal sticky tape"

A Russian company from Obninsk developed a novel technology to obtain wrought alloys based on Al / Al-Mg / Al-Zn-Cu, with a high content of reinforcing components: Zn (12-12,5%), Mg (>10%). The new technology enables manufacturing metal components (casings, etc.) without welding, just by pressing the edges together. The new systems are nonequilibrium in regard to deformation. One unique feature of these systems is the presence of atomic (molecular) diffusion into other materials under mechanical impact. The technology allows introducing new, more energy-efficient approaches in various sectors including machine-building, car manufacture, shipbuilding, and aircraft building. Materials, produced using this technology, can be widely used as a new generation of construction materials: they are as strong as steels, but 3 times lighter; they also have high corrosion resistance.
#2012-01-215