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MESSAGE FROM NEIL B. GODICK

We have written several times about corruption in Russia. It's getting worse not better. It's becoming more creative. How's this for greed?

The nineteenth-century Russian novelist Nikolai Gogol said his country has two problems: roads and fools. If you have ever been to Moscow you would immediately understand his comments about *roads.* Roads, a new study claims, costs many times more to build in Moscow than in U.S. and European cities. The reason - corruption.

Moscow's current mayor Yuri Luzhkov has been in office for 17-years. Critics and political opponents claim, "We'll never solve the problem of traffic under Luzhkov, no matter how much money is allocated for road construction. The exorbitant prices are directly linked to corruption and ties between road builders and authorities. Traffic jams are about corruption."

A 2008 nationwide poll by the Public Opinion Foundation showed that Moscow is regarded as the most corrupt city in Russia, with 42 percent of Moscow residents polled admitting they had given bribes to public officials.

Construction of Moscow's new, fourth ring road is expected to cost $380 million per mile. Road construction in China, the United States and Europe hovers between $4.8 million and $9.6 million per mile.

We do not intend for these 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.

Electric Heaters

A Russian company developed and has had certified commercial scale, energy efficient, three-dimensional electric heaters. The heaters are designed to work in humid conditions and aggressive environments.

Advanced technologies for low-temperature heating (300-400 K) must provide the maximum energy efficiency while meeting the heating tasks specified. These requirements increase the significance of the local low-temperature distributed surface heating by safe composite electric heaters shaped as films, plates, panes, mats, etc. Technology for industrial heaters has been developed: 1) for heating young livestock, utility space, hothouse soil; 2) for heating induction-type meters in switchboard panels, process and auger-type grain heating; 3) for heating water conduits, pipes, and valves in oil and gas pipelines; 4) for heating containers in technological processes.

The electric heaters' characteristics are better than existing analogues:

- surface temperature without heat conduction ranges from +10 ºC to +80 ºC ±15 %;
- insulation resistance is at least 1000 MOhm
- leakage current is less than 25 µA;
- dielectric breakdown voltage is at least 9.0 kV;
- mean time to failure is at least 50000 h.

The heating device's principal advantages are: energy efficient distributed surface electric heating, flexible production parameters such as shape and configuration, required surface temperature to specified voltage, efficient operation in humid conditions and aggressive environments.

Power Generation

A research and manufacturing business in Samara develops technologies and equipment for obtaining syngas from low-grade fuels and organic waste suitable for gas-piston power stations and boilers.

The business developed a new equipment complex that can be used in most factories, multi-family housing buildings, and municipal service facilities that have the necessary quantities of low-grade fuel or produce sufficient organic waste. The equipment produces syngas, heat, electric power, cooling, and liquid hydrocarbons.

Today, in the market, there is competitive equipment to this technology produced by Russian, US, German and Italian companies. The competitive equipment is quite expensive. In addition, all known installations consume considerable metal and require both high labor and power inputs for maintenance. These operating requirements preclude a low-cost end-product - gas, heat, electric power.

The new technology produces and purifies syngas, doubles or triples the thermal capacity of syngas obtained, lowers the power inputs 10 times, and reduces the equipment's dimensions. This results in a 25-40 % increase in heat and electric power production efficiency. From one ton of brown coal with a 4200 kcal/kg calorific power the equipment can produce 3000 m^3 of syngas per hour. If this gas were used in a gas-piston power station it would produce 1.8 MW of electric power and 3.6 MW of accompanying heat. The power inputs for obtaining syngas is only 20 kW of electricity. The investment payback period is 2 years. When using industrial and agricultural waste that does not require costly preparation for fuel briquettes the payback period is reduced to 8-11 months.

NEMS Technology

Russian scientists have developed a technology for integrating NEMS structures for producing gas sensors, non-volatile memory, and new a membranes type: active nanomembranes.

The authors' new technology facilitates forming integrated electromechanical structures whose controlled element is measured in nanoscale. The controlled element is separated from the control electrode by a coaxial cylindrical gap whose size is controlled at the nanometer or sub-nanometer level. The gap's minimum width is 0.33 nm. The structures described are an array of vertical carbon nanotubes piercing a conducting layer. Each nanotube is separated from the conducting layer by a cylindrical gap. To ensure the nanotubes separation from the conducting layer, a new method for self-combination was developed.

The technology provides a method to obtain long nanomembranes whose pore geometry is controlled in 100 to 0.33 nm range. Obtaining these structures is key to developing "molecular sieve" type membranes. This technology has an additional result: forming each pore in the form of two independent electrodes. This allows creating a controllable electric field within the pore. Thereby, there is the added effect on molecules of the divided medium. The result is a new membrane class: active molecular sieves. Because the central electrode is an elastic element (carbon nanotube) the pore geometry can be controlled in situ. It is also possible, when controlling mass transfer in pores, to use mechanical resonance effects.

The nanoelectromechanical (NEMS) structure enables a gas sensor based on the resonance operating principle to be realized. The NEMS structure ensures a simple way for measuring resonance frequency. The Van der Waals forces play an essential role at the nano-level. Using the resonance effect, the NEMS-sensor makes it possible to carry out direct probing with the analyzed medium molecules.

The NEMS nanomembranes have immediate applications for separating hydrocarbons, isolating hydrocarbons from solutions and emulsions in water, and filtering physiological and pharmaceutical liquids. Medium-term and long-term applications include air separation, water purification, and energy-saving water desalination.

Spin light-emitting diodes

A research organization from Nizhniy Novgorod has developed spin light-emitting diodes, the devices combine ferromagnetic and semi-conductor properties. This combination enables it to be integrated into semi-conductor circuit designs for data processing and storage.

The spin LEDs make it possible to encode information by orienting the charge carriers spin and converting it to circularly polarized radiation. The conversion's principle acts as follows: during radiation recombination the magnetic moment corresponding to the electron spin's direction is transferred to a photon. The resultant radiation is circularly polarized. The circular polarization sign is unequivocally determined by the spin direction. This principle can be applied:

- To encode data transfer via optical links;
- To develop high-sensitivity subminiature magnetic field sensors for recording and reading data on hard magnetic disks;
- To develop spin-optoelectronic devices with magnetic control of light polarization.

The spintronic devices currently used in industrial systems are based on ferromagnetic metal structures. New devices using this technology are made from a special material. This material can be integrated with semi-conductor circuit designs for data processing and storage.

For the newly developed spin LEDs it was possible to obtain circular polarization of the quantum well value at the best world level, i.e. over 45%.

Superplastic molding

A Russian research organization has developed a technology for obtaining bulk nano and microcrystalline alloys for superplastic molding making it possible to form intricate-shape products in a single operation.

Using the superplasticity effect makes it possible to form intricate-shape products in a single operation. This technology is meant to substantially improve the technical level and reduce costs for many machine-building sectors: aircraft construction, automobile production, ship-building, motor industry, and others.

While developing the superplastic deformation technology, the following results were obtained:

1. Microcrystalline magnesium alloys of the Mg-Al and Mg-Zn systems with the effect of low-temperature superplasticity with enhanced parameters: ultimate elongation 600–800 % at deformation temperatures of 200–250 ºC.
2. Nano and microcrystalline aluminum alloys of the Al-Mg-Sc-Zr system with the effect of high-speed superplasticity. The characteristics obtained include: ultimate elongation over 800 % at deformation rates of 3 mm/s.
3. New piston alloys of the Al-Si system with the superplasticity effect. The characteristics obtained include: ultimate elongation over 700 % at deformation temperatures of 500 ºC.
4. Nano and microcrystalline copper alloys for electrotechnical

applications. Key results: strength increase – 3 times and hardness increase - 4 times while preserving the plasticity and thermal stability up to 400 ºC.

5. In the nano and microcrystalline aluminum alloys of the Al-Mg-Mn (AMg6 type) system, the effect of simultaneous doubling of the strength and plasticity at room temperature and the effect of high-speed superplasticity at elevated deformation temperatures were obtained. The characteristics at room temperature obtained include: strength – 450 MPa, plasticity – 25 %, and superplasticity (350 %) at deformation temperatures of 250 ºC.

Ultrapure silica

Researchers at the Limnology Institute, RAS (Siberian Branch) have developed a new method to obtain ultrapure silica. Its special feature lies in separating silica from diatomic algae biomass produced in a photobioreactor.

Ultrapure silica is a hi-tech product that is in ever greater demand. It is used in optics, electronics, and food-processing industries. Existing silica purification production technologies are complex. This complexity makes this product expensive.

Amorphous silica obtained from existing methods cannot be used for producing optical products and this silica has to be heat-treated before further application.

The Limnology researchers learned that diatomic algae accumulate amorphous silica in their cell walls. An additional important feature of diatomic algae is that they can synthesize essential polyunsaturated fatty acids. Developing and applicating preparations based the polyunsaturated fatty acids complex obtained from diatomic algae has advantages over similar preparations from other sources.

The searchers at Limnology Institute, RAS (Siberian Branch) (M.A. Grachev, E.V. Likhoshvay, et al.) developed a new method for obtaining ultrapure silica. Its special feature is separating silica from the diatomic algae biomass produced in a photobioreactor. The scientists state this will greatly simplify the silica production by process reducing it to separation of ready-to-be-processed diatomic valvules from organic components.

The scientists are able to isolate a complex of polyunsaturated fatty acids by extraction and free the remaining cells from organic components to obtain silica from the biomass. Producing amorphous silica from envelopes of diatoms in this way is a new technology.

To make the new technology work there must be sufficient diatom biomass available. Therefore it became a separate project task to identify optimum conditions for growing diatomic algae. The scientists selected conditions for cultivating diatomic algae in model conditions on a microscale, and then the data obtained were applied to a 100 l photobioreactor model. As a result, 350 g of diatomic biomass were obtained.

The preparation obtained following the new isolation technology contained up to 78% of polyunsaturated fatty acids, with eicosapentaenoic acid accounting for 40 % of those. The new method enables extracting 88% of the polyunsaturated fatty acids from the raw materials. The isolated silica is classified as an ultrapure material.