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Dear ,

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MESSAGE FROM NEIL B. GODICK

We begin 2008 with exuberance and confidence that Russian science and technology will find greater and wider success in markets in Europe and the United States. The trend is apparent: more companies across a wider industrial base are working with Russian technology developers. First time seekers are growing and experienced seekers are expanding their efforts. This month we focus on *materials sciences* and *health sciences.*

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.

Materials Sciences

Employees of the Institute of Geosphere Dynamics, RAS have begun research of nano-particles formed during mass chemical explosions. The scientists are developing a method for producing powders from nano-particles by means of controlled explosions. The resultant powders have practical application to protect against certain kinds of biological agents and for solving problems connected with environmental pollution.

Scientists from the Institute of Geochemistry and Analytical Chemistry, RAS and Institute of Metallurgy, RAS have developed algorithms and software that makes it possible to predict what will happen to metals exposed to long-term neutron radiation.

On the basis of the findings it is possible to produce steel alloys so that the enhanced steel could be used to improve safety of nuclear reactors.

Thermonuclear fusion is a source of energy, generating fast neutrons with high penetration power. Walls and other parts of a reactor often become a source of induced radioactivity. This is caused by previously stable metal isotopes, which turn radioactive.

Iron is the essence of any steels, including radiation-proof and heat-resistant steels. These are usually are used for building reactors. Iron

loses radioactivity after several tens of years and becomes safe for the reactor staff. However, some other elements, such as niobium, molybdenum, nickel, and aluminum, have long half-lives. Thus, steels for nuclear reactors should contain safe alloy additives and undergo careful control before becoming a wall in a highly radioactive environment.

Health Sciences

Russian biologists from the Institute of Molecular Biology, RAS, in cooperation with the Research Institute of Pediatric Hematology (Moscow) and their American colleagues from Children's St. Jude Hospital (Memphis) have developed a microchip for genetic diagnosis of contraindications to thiopurin medicines. Thiopurin medicines are used to treat lymphatic leukemia, rheumatoid arthritis and autoimmune hepatitis, and are also used after organ transplantation. The problem with this medicine is that this enzyme in some people (one in three hundred) there is no synthesis and in 10% of people the synthesis is very low due to genetic mutations. In such cases, application of the medicine is dangerous and can lead to serious complications and even patient death.

The scientists have studied genetic variations (alleles) of the gene responsible for synthesis of thiopurin-C-methyltransferase, and identified about twenty mutations in this gene that lead to the enzyme's reduced synthesis. The scientists have designed a microchip in which they applied (DNA sections that are complementary to the mutated DNA) short nucleotide fragments onto the polymer in microcells.

For testing, the patient's DNA is separated, segments are labeled with a luminescent label, and its mutating sections are hybridized with nucleotide fragments on the microchip. These luminescent labels are then used as markers to indicate whether the mutation is present in the patient's DNA, showing contraindications to the medicine. Similar microchips can be used for detecting contraindications to other medicines.

Specialists at the Institute of Laser and Information Technology Problems, RAS and the Moscow State University have developed a unique device for examining the eye's retina. This device will allow ophthalmologists to see the retina image clearly, without distortions. The device combines a digital fundus camera, which produces a retina image, and an aberrometer (the device for automatic measurement of complete aberrations of the human eye), which eliminates distortions caused by the optical medium of the patient's eye that were until now considered unavoidable.

Since the development of fundus cameras the researchers have been unable to make a picture sufficiently distinct (at micron definition). It is the eye itself that blurred the final image. Physicists call this phenomenon aberration - imperfection of the optical system. A

similar problem was solved long ago by astronomers using distorting mirrors. To over come this problem it is necessary to know how the light waves' direction changes on the way from their source through to the observer and how to correct the image. Physicists applied this particular technique to the fundus camera design to measure the distortion and to correct it. An additional infrared laser and a special "ruby" mirror were used to implement the idea. A moment prior to the probe laser starting operation, the aberration correction system is switched on. The eye-safe infrared laser will send its ray of light to determine how its intensity and direction will change on the way "down to the retina and back". The sensors, having recorded these changes, send a signal to the "distorting mirror", which in response distorts it in such a way that it compensates for the changes. The compensation is not for the infrared ray but for visible light - the one that allows for obtaining the proper image. Only after the mirror is "tuned up", taking into account individual peculiarities of the eye under investigation, the ordinary laser is switched on and sends an impulse of light. The light which, having been reflected from the eye-ground and having been "corrected" with the help of the "ruby" mirror, gets onto the digital camera matrix.

As a result, retina images at a micron resolution are obtained. These images are several times better than ordinary digital fundus cameras. This allows the ophthalmologist to quickly (at the rate of one shot per second) to obtain an excellent image of the object in question, without injuring the eyes.

Chemistry

Novosibirsk scientists have synthesized artificial analogues for natural substances - water soluble sulfur-containing phenol compounds, which show useful biological properties like vitamins, amino-acids, natural phenol compounds.

Scientists have proven that these synthetic compounds show antioxidant activity - they protected lipids and proteins from oxidation. Such activity is due to peculiar chemical structure of phenol compounds, which contain sulfur atoms together with oxygen atoms. Oxygen atoms neutralize unpaired electrons of free radicals, thus eliminating their maleficent effect on a cell. Sulfur atoms act the same, thus adding even more antioxidant activity to synthetic compounds.

Another significant advantage of these compounds is their solubility in water, which provides fast absorption and transfer of the substance in an organism.

This group also discovered anti-inflammatory activity of synthetic phenols. This activity results from their ability to affect genes responsible for inflammation processes.

Security Systems

Russian specialists at the Volgograd Technical University have

developed a human face biometric identification system. This system is capable of solving complex problems connected with face recognition and analyzing the images obtained. The authors have developed a hybrid algorithm for rapid recognition of human faces from digital images. A feature of this algorithm is a three step process that accelerates and enhances the search's accuracy. It outperforms the traditional *AdaBoost* method. The computation complexity of this algorithm is a linear function from the quantity of pixels. The base algorithm is a square complexity. The basic innovations are: using color information, the mechanism of framing ellipses, and the mechanism of turns.