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February, 2008

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MESSAGE FROM NEIL B. GODICK

The US (in November) and Russia (in March) will elect their next president. Predicting who may be the next US President is open for wide speculation, predicting who will be the new Russia President can be stated with great certainty – Dmitry Medvedev. Mr. Medvedev is a young man, owes his political position to President Putin, and has a background in business. Medvedev, considered a liberal by Russian standards, is currently serving as deputy prime minister. In this position, his portfolio is domestic policy. Mr. Medvedev oversees Russia's science and technology budget. Like President Putin, Mr. Medvedev is supporting the philosophy of weaning Russia off of a natural resources based technology and on to a technology and information based economy.

This month we present developments in *materials sciences, health sciences, biotech, and physics.*

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

Researchers at the Institute of Solid State Chemistry, Russian Academy of Sciences (Ural Branch) and BNTU *Meteolit* Science-and-Technology Estate (Minsk) have developed a technology for obtaining new composite powders for improved performance gas-thermal coatings. The scientists use refractory compounds, mainly powders or conglomerations of metal particles. For source materials, the scientists chose powders based on borides and oxides of titanium, chromium, zirconium, silicon and aluminum that were subjected to plasma treatment. Their improvements to earlier technology make it possible to separately supply refractory particles to the already generated working stream, and also introduce the particles into the stream of ionized gas at a predetermined angle.

Using this technology, new materials can be synthesized from mechanical mixes and conglomerates of metal particles. From such mixes, by means of evaporation, ultradisperse powders with particle sizes of less than 20 μm are obtained. These powders are used for manufacturing various products by the powder metallurgy technique.

From the conglomerates, a coarser powder is obtained. They are crushed, fused and transformed into spherical particles suitable for making flexible string materials and applying gas-thermal coatings.

Scientists of the All-Russia Electrotechnical Institute (VEI) (Moscow) have developed and patented an all-purpose technology that can help produce high-voltage insulators of any size or shape. The invention produces insulators that are simpler, less expensive and have improved performance compared to conventional insulators. A special feature of these insulators is: instead of traditional porcelain the developers use a material based on an organosilicon polymeric compound. The unique feature of the technology is a new way for applying the polymeric jacket onto the bearing element of the item.

The essence of the VEI technology is:

- squeezing out the polymeric mass from a specially designed extruder,
- the mass is wound onto a rotating base, like a thread on a reel
- the winding continues until the mass becomes sufficiently thick
- then the product can be annealed, eliminating the need for high pressure methods and molds.

The insulator jacket obtained in this way is spiral in shape. Standard design insulators are similar to a pile of porcelain plates the top surface. This naturally accumulates dust or, if it rains, water. The new spiral shape assists in removing water because water will flow down in a continuous stream from the insulator surface. Considering that these polymeric compounds are hydrophobic, it becomes clear that insulators made with this new technology are always cleaner and drier (and thus more reliable) than the usual porcelain ones.

These insulators are safer than those from porcelain. In case of an electrical breakdown or a shock, porcelain or glass insulators shatter, scattering splinters. Polymeric insulators and insulating jackets do not shatter under any circumstances as polymer items are flexible and, at worst, they will simply tear. They are also lighter than porcelain.

The technology of forming insulating jackets developed at VEI enables production not only of insulators, but also of any round insulating items, including hollow insulators. Such designs are necessary for enclosing high-voltage equipment in order to protect the equipment from the environment medium and protect the environment from high voltage. In the final analysis this makes it possible to make electric power transmission lines (and high-voltage equipment as a whole) safer and more reliable.

Health Sciences

Russian scientists have studied the effect of an artificially synthesized preparation (Fenozan) on leukosis development. A

new preparation, *Nelarabin,* produces anti-leukosis activity even in minute doses.

The scientists explain Fenozan's results by a different mechanism of action when used in minute concentration: in this case the preparation does not directly affect the body. Instead, Fenozan acts as a regulator. According to the researchers, Fenozan holds great promise as an agent for treating and preventing leukoses and other types of cancer. Fenozan shows therapeutic properties in minute concentrations and all toxic effects are absent.

By penetrating cancer cells, Nelarabin causes the cell's death. The preparation can be used to treat patients with acute and recurrent T-cell lymphoblastic leukoses and T-cell lymphoblastic lymphomas that are difficult to treat by usual chemotherapeutic methods. Moreover, Nelarabin can be used in treating T-cell lymphoblastic leukoses and T-cell lymphoblastic lymphomas to stabilize patients' status before bone marrow transplantation. The preparation was developed from domestic raw materials, resulting in a less expensive treatment. Nelarabin is undergoing for clinical tests.

Biotech

Research has shown that proteins of photosynthesizing bacteria can be used for photocurrent generation. In Russia, this problem is being researched by specialists at the M.V. Lomonosov Moscow State University, the Institute of Problems of Chemical Physics, RAS, the Moscow Physicotechnical Institute, and the Institute of Chemical Physics, RAS. Proteins of photosynthesis systems (bacteriochlorophyll, bacteriopheophytin, and ubiquinones). The research demonstrated that these proteins are natural bioaccumulators of solar energy.

An excited bacteriochlorophyll molecule passes an electron via a chain to other proteins in the photosystem. The scientists built proteins from the reactionary center of purple bacteria photosynthesis into porous nanocrystalline titanium oxide films.

Mesoporous TiO_2 films are produced from nanocrystalline powders added to a special paste. They were applied to glass with a conducting titanium-indium oxide coating. The film was dried and fired, and then the plate was soaked in a solution of photosynthetic proteins. This process produced a working electrode. Because of the thickness and porosity of the film, many proteins adhere to it resulting in a protein concentration 160 times higher than that in solution.

The proteins on the working electrode retain their activity even after two weeks of storage in a cooler. Illumination of the electrode by red light (to which only proteins react), generates an anodic photoelectric current of approximately a μA. Titanium oxide also reacts to white light, but the presence of photosynthesis system proteins in the

electrode more than doubles the photoelectric current.

Scientists note that nanoporous semiconductors possess not only a very high sorbability, but also an enormous energy variety of surface states, which greatly affects the electron transfer process.

Physics

Russian scientists are developing a small but very effective device – the portable gas analyzer. Its function is the same as that of the nose of a specially trained dog, however, unlike the latter, it will not simply detect hazardous impurities in the air, but will also determine their quantity and chemical structure. The gas analyzer that can become an alternative to trained dogs for finding drugs and explosives is being developed by scientists from the Institute of Solid State Physics, RAS (Chernogolovka) jointly with their colleagues from *Aspekt* Research-and-production Center at the United Institute of Nuclear Research (Dubna).