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January, 2010

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MESSAGE FROM NEIL B. GODICK

When asked to describe Russia I frequently respond by saying there are three Russias:

- Moscow, Russia – the vibrant government, financial, and business center
- St. Petersburg, Russia – the cultural and intellectual center
- and *the rest of Russia* – most of which is suffering economically and culturally

Demographers and economists are now taking note of a particular aspect of *the rest of Russia.*

Tolyatti, a company town, is in southern Russia on the Volga River. Autovaz, Russia's largest domestic auto manufacturer is based there. For Tolyatti's 700,000 inhabitants, the next weeks and months will be critical. Autovaz is battling bankruptcy and huge layoffs.

Russia has hundreds of company towns and cities like Tolyatti, where a single industry or factory accounts for most of the local economy.

Fearing social instability and unable to keep many far-flung Soviet-era enterprises afloat, Russia's government has launched a wide-ranging review of 400 company towns. The government must decide if they will restructure the local enterprises and bring in new sources of employment or shut them down and move the people to new lives and uncertain futures.

Most of these company towns are not more than half a century old, having been built under the Soviet Union's rapid industrialization drive starting in the 1930s. Life in these cities has been harsh over the span of their existence.

Following the fall of Communism, many of the company towns have little economic reason to exist. Their products are uncompetitive with imports. They have seen little investment and have received minimal support from the government. With the onset of the world economic crisis, many of these towns have gone from limping along to a slow death spiral.

Mismanagement, perhaps more than the lack of capital, at these factories is the root of the problem. Politicians, converted bureaucrats managing these enterprises, and businessmen bicker about who is at fault.

While trying to find a solution, the social dimension is dire and getting worse. Many people are unemployed and more are underemployed. The effected employees pick up part-time jobs or stand round idly in parks playing chess or football.

Businesses that supplied or provided services to the principal employer in these company towns have seen a steep drop-off in business or have closed. Employment centers and social services offices are packed and unable to cope.

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.

Eat a caterpillar and improve your health status

Specialists at **Pyatigorsk State Technology University** are producing functional drinks from silkworms' dried larvae. They have proved that the silkworm larvae provides the body with the necessary quantity of animal proteins, vitamins and inorganic compounds.

Since ancient times the silkworm has been useful to mankind. This plain looking butterfly's larvae cocoons produce silk threads. Now it is possible to make functional foods and drinks from caterpillars. The studies performed by Prof. Tatyana Kalashnova's group proved that 100 g of dried silkworm caterpillars contain 53.5 g of protein with all irreplaceable amino acids, 7 g of lipids, vitamins B1, B2, A, E, the macroelements: calcium, magnesium, sodium and potassium, and microelements iron, copper, zinc, and manganese. This ratio is capable of providing humans with their daily required nutrients.

The scientists further claim that functional foods made from silkworm caterpillars will help regulate gastrointestinal tract peristalsis, have antimicrobial effect, enhance body protective functions, stabilize blood pressure, improve immunity, and control body weight.

Bioprostheses to be made in Krasnoyarsk

Recently in Krasnoyarsk, Russia's first pilot plant for biodegradable polyesters began producing - Bioplastotan. These polyesters appear to be very promising materials for manufacturing bioprostheses. Production was set up at the **Institute of Biophysics, RAS (Siberian Branch)**. The scientists found that *Bioplastotan* could be useful in surgery as a suture material, a barrier anti-commissure agent, and an endoprosthetic material for reconstructing biliferous tracts.

For patients with seriously diseased organs sometimes their only treatment plan is transplanting donor organs. But

- organs are in short supply,
- time available to complete artificial prostheses is limited by the time available to maintain the organ's functions.

An approach to overcome these restrictions is developing artificial organs and tissues from a biological base that are compatible with living tissues.

Despite appreciable successes, artificial organs are not yet developed. Further, there is the unresolved issue for controlling the biopolymer decomposition rate. For medical purposes, different material decomposition rates are required. Current biopolymers do not meet this requirement limiting medical applications.

Polyhydroxyalkanoates (PGA) was recently discovered. They are biocompatible and decompose in the human body. Their application range can be quite wide: from plastic surgery to cellular engineering and transplantology.

The Russian Institute of Biophysics, RAS (Siberian Branch), Krasnoyarsk is conducting active PGA studies focused on solving medico-biological problems. Scientists have developed an original technology for synthesizing polymers with specific chemical structures. From these studies' results medical-purpose materials' pilot production has started. The production includes a whole family of polymeric products:

- suture fibers,
- flexible films and membranes,
- microcapsules and microparticles,
- dense and porous structures,
- structures with ceramics and loaded with biologically active substances and cells.

The scientists have shown good prospects for using PGA in reconstructing osteal tissue defects in maxillofacial surgery, orthopedy and traumatology, and for designing artificial organs. In 2008, jointly with the Chair of General Surgery, Krasnoyarsk Medical University, a study was made to investigate using PGA in abdominal cavity surgery as endoprostheses for reconstructing biliferous tracts and as a suture material for intestinal sutures. The results obtained made it possible to begin testing the polymeric products in clinical conditions.

The scientists have protected their developments with Russian Federation patents, published Russia's first monograph on the polymer's biotechnology and materials science, and registered their trade mark - *Bioplastotan* for the material and medico-biological products.

Technical eyes for robots

Researchers at the **Laboratory of Integrated Sensorics, TsNII RTK** have developed machine vision methods based on structured laser illumination. The devices enable improved vision for new mobile robot classes. Improved vision is especially important for controlling process safety when human life or health hazards are involved. Application examples are highway construction, high-altitude assembly operations, in rolling mills, and blast furnaces.

According to Nikolay Gryaznov, Head of the Laboratory Integrated Sensorics, machine vision based on structured laser illumination is much more effective than the scanning methods currently used. The devices developed at the Institute of Robotics have a number of advantages.

- they are eye-safe and invisible to the eye (infrared laser).
- they are light weight. The system developed by TsNII RTK weighs less than one kg.
- they are energy efficient. Laser illumination is used only at the moment of shot exposure, being switched off at all other times. On the whole the consumption will be on a low level, equal to the consumption of a miniature television camera.

The Authors claim "The key idea realized by using our method is in dividing the functions on data acquisition and data processing". "We want to make the measuring system smart so that the technical eyes would not only see, but also pre-process data and send to the central processor only the data, which it needs."

The prototypes are built with laser diodes.

Good prospects for magnetic particles

The **Laboratory of Inorganic Materials Science, Moscow State University** develops methods to obtain ultradisperse oxide material particles. The researchers think these particles can be used to:

- increase the magnetic recording density several times,
- strengthen vehicle road grip,
- improve shock absorbers,
- develop refrigerator without gaseous coolants,
- make permanent magnets,
- optimize diagnosis of diseases and
- overcome cancer cells.

During their research, scientists studying strong magnetic materials noticed that their properties undergo radical changes during the transition to submicroparticles, submicro, and subnano-objects. It is known that a ferromagnetic object, such as an iron nail, can spontaneously break into small fragments (domains) each with a different magnetic polarization. These domains cancel each other. The result is the nail becomes nonmagnetized. But if the object's dimensions (a ferromagnetic particle) are below a micron, it becomes a single-domain object. It behaves like a permanent magnet while preserving all the material's characteristics. Prof. Pavel Kazin and his group study the properties of micron and submicron sized particles.

Prof. Kazin says "We are developing methods to obtain ultradisperse oxide material particles (ferrites) that contain iron oxide in their structure. These particles are single-domain. Each is a tiny permanent magnet, which is impossible to demagnetize. It can only be remagnetized by changing the spontaneous magnetization vector's direction. This makes the fragment radically different from the source bulk material. Because it is a single-domain particle the most important characteristics for permanent magnets, e.g. coercive force, reach their peak value. Our problem is to develop methods for synthesizing controlled-size particles with controllable magnetic properties.

Ultradispersed particles are interesting for magnetic recording. This field is already very well developed, and today's hard disks have large memory densities. These disks have a disadvantage - the nanometric grains on their surface which record the data are not ordered and therefore the information is stored on several grains, instead of one. If these nanoparticles are similar in size, it produces a self-organization effect. With ordered structures (e.g. 2D particles with hexagonal packing) it is relatively easily to make a recording on each particle. The effect is that on each particle it is possible to record an information bit. If the particle size is 10-20 nm, the recording density increases tenfold in comparison with that which is achievable today.

There is another advantage to these particles, because the source materials are relatively inexpensive, the ultradisperse particles are also inexpensive. Moreover, they are chemically inert and therefore can be used where a stable data recording is needed.

There are additional more active developments for use. Fluids containing superparamagnetic particles in medicine are being developed. In medicine they serve as markers. Superparamagnetic nanoparticles easily form stable suspensions and colloidal solutions. If specific proteins are attached to them they can be used in magnetic resonance tomography as a tracer. They work well as tracers as it is possible to see where they accumulate. This process provides the opportunity to observe various processes in the body and to see how various diseases develop.

Physicians foresee using superparamagnetic particles in cancer treatment. Cancer cells perish at temperatures just above 40 degrees. If particles are introduced into a cancer tumor and apply a variable magnetic field, the particles will be heated locally and the cancer cells will die. Experiments are being conducted on animals in several Russian institutes to further this treatment.

Liquid crystals with firm character

In the **Laboratory of Chemical Transformations of Polymers, Department of Chemistry, Moscow State University**, scientists devote most of their time to basic research. Concurrently, they are working on new principles to

- develop materials for data recording and storage;
- to simplify LC displays' design and reduce cost ;
- improve protection against counterfeiting;
- develop indicators for hazardous metals.

The simplest liquid crystal phase (nematic) consists of elongated molecules oriented along a definite direction. Aleksey Bobrovsky, senior researcher at the laboratory explains: "The simplest analogy would be matches chaotically placed in a big box: if the box is shaken, the matches will settle down to one side, parallel to each other. It is this phase that is used in all LC displays. There are more complicated phases where oriented molecules are packed into layers or twisted into a spiral. I am now studying these spiral structures (cholesteric mesomorphic phase) where molecules are found it the orientation order at distances comparable to the wavelength of light with a periodicity in the structure. It arises due to spiral twisting of molecules. It gives the system some very interesting optical properties. If one introduces light-absorbing molecules then, by exposing it to UV, one can change the molecules' structure and geometry. This absorption leads to a change in the pitch of helix which causes a shift in the selective reflection wavelength. What can we gain from polymers forming a cholesteric mesomorphic phase? First, it is a new, unusual method for recording "colored" optical information. At room temperature LC polymers are mostly in the glassy state. By changing, at high temperatures (80-120 degrees), the pitch of helix via illumination and then cooling the film to room temperature, it is possible to fix the image obtained for many years to come.