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September, 2008

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## MESSAGE FROM NEIL B. GODICK

Russia's public health care is a disaster. What was a source of great pride and a showpiece under the Soviet communism is the recipient of public ridicule and criticism.

Under the communist system, health care was free. Though the system was uneven, it worked. All citizens received care, not the care of Europe or the US, but care. Today, for most Russians the system does not work and it is not free. The cost for treatment has been, in most part, shifted to patients and their family members.

During the transition from the *old free system* to the *current pay system,* the infrastructure deteriorated. Hospitals are dilapidated, medical service professionals are scarce and underpaid, equipment is often not available, and the equipment that is available is often several generations old.

But, help is on the way. In mid August, the Russian government stated that improving public health care system is a priority. It promised funding to fix the system. Part of the plan is funding for drug discovery, both *chemistry and biotechnology.* The goal is for the drug discovery system to be so strong that it will help Russia's citizens and so Russia can compete in the international pharmaceutical marketplace.

*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 - Joining

**Russian physicists have developed a method that enables expansion of electric welding** applications. The new method facilitates the process of welding metal parts, including very thin ones, making the seam more even, and reduces the amount of rejections.

The essence of the method is: instead of one electrode the welder will have two closely-placed electrodes. There is a thin metal wire between the electrodes that guarantees a strictly dosed amount of metal heating in the place of a future "stitch". This assures a quality seam. When electric current passes through the wire, it heats the cathode. At the same time the wire (which is a few micrometers thick) is strongly heated, melts and finally evaporates. This is similar to what happens when a fuse blows from a power surge in a circuit.

The cathode, heated by the passing current, emits thermoelectrons (this phenomenon is called thermionic emission). In the electric field between the electrodes, metal ions are evaporated, ionizing the metal. The resultant metal ions bombard the cathode and raise its temperature even higher. They fuse the metal in the place to be welded but do not to make a through hole in it. When all the wire evaporates completely, the circuit is broken, and where the wire used to touch the metal surface, a "stitch" is formed that reliably connects the parts together.

This type of welding has two useful features. First, it is possible to select conditions to make the "stitch" linear. This linear stitch's length is slightly more than the length of the wire connecting the electrodes. For example, at a wire length of 0.5 cm the length of the stitch will be 0.55 cm. Secondly, it was determined that the metal melts much better at the edges of the welded parts and therefore the seam is thin and even.

This the new method allows welding different metals, including those with substantially differing melting temperatures. The inventors welded plates from nickel, yellow metal, copper (which is known not to weld so well), and steel with aluminum. It was found that the thickness of welded parts could be fractions of a millimeter thick, and the thickness of the wire to be used could be from tenths to hundreds of a millimeter. Only a small voltage is necessary to achieve the results.

Materials Sciences – Nano Coatings

**Moscow specialists have developed a method to determine the strength of nano-sized coatings** applied onto polymeric film surfaces. This is achieved by stretching the film and observing the relief formed on its surface.

Because of micro defects when film is stretched in one direction, the coating applied on it stretches and divides into multiple fragments. Each defect gives rise to a crack upon stretching and, as a result, a community of various sized fragments is formed on the polymeric film surface. As the film continues to be stretched each of the formed fragments works under a load.

The voltage in each fragment of the nano film is distributed unevenly: the further from its boundary the higher it is, attaining its maximum in the center of the fragment. As a result, each fragment disintegrates into two equal parts. The breaking continues until the polymeric emulsion carrier transfers to each fragment a voltage sufficient for its destruction. When this limit is attained, the fragments, when further extended, cease to break, and simply move away from each other. At this stage all have approximately equal size and are built in rows, forming a peculiar relief. The relief has a regular structure and is strictly oriented along the extension axis. By the parameters of this relief, it is possible to judge the mechanical properties of the coating material.

Using this method, the scientists established that the strength of a metal, to a certain limit, in sputtering depends on its thickness. When the thickness of a metal layer becomes less than 15-20 microns (the exact value depends on specific conditions), the strength of the metal starts to rapidly increase.

Even the thinnest nano films have defects capable of causing their destruction. The scientists have established that these defects reduce the coating resistance 10 times. Therefore it is very important to consider the imperfections of solids.

Chemistry – Identification

**Criminals hardly ever make explosives themselves – they usually steal them.** A method proposed by a group of Siberian chemists makes it possible to find where they were stolen from. They have patented a method that enables identifying the explosives' origin. The method requires introduction, during manufacturing, of a small quantity (literally traces) of a special chemical "label" into the explosive. Once labeled criminalists will have at their disposal a *fingerprint* that unambiguously identifies the manufacturer and the batch number of the material.

No foreign components have to be added to the explosive. Therefore without special knowledge it is simply impossible to define whether or not the explosive has been marked. The compounds used as markers are part of the explosives containing industrial products. The only difference is: the ratio of these compounds has been changed. This makes each labeled product somewhat different. The difference is not great, but is sufficient to reliably distinguish one marked batch from another. The marker is determined by analytical techniques with high sensitivity for the markers.

Commercial products that include explosives have industrial markings identifying the manufacturer, production batch and other data necessary for identification. During use, these industrial marks are destroyed. Therefore, to identify the source of an explosive containing product, it is necessary to conduct an analysis of the residue. This method makes it possible to identify an explosive faster, easier and with higher certainty.

To identify admixtures, the scientists introduce "native" compounds for target products, in absolute proportions. Since there are almost an unlimited number of hydrocarbons, it is possible to make an almost boundless variety of "labels". It is practically impossible to find each specific label and identify it without special equipment. Special instrumentation is needed and technical capability is also needed for the identification. The task of destroying or replacing the "label" with another is unrealistic. It is not difficult to add the mark in specialized laboratories.

The principles underlying this identification method can be applied to the quality control process for identifying the manufacturer, production batch and other data in chemical production.

Physics -
Cold plasma

**Researchers two institutes outside of Moscow have developed cold plasma techniques for new effective** and energy efficient methods to inactivate biologically harmful admixes (pathogens and chemical toxicants) in gases, liquids and on surfaces. The technology has application in medicine, industry and environmental protection.

The advent of new polymeric medical materials requires delicate, rapid, inexpensive and safe sterilization methods. As a rule, conventional sterilization procedures and disinfectants imply using dry and wet heat, filtration, radiation and chemical (biocidal) treatments. These methods are mainly labor and time consuming, expensive, and not always ecologically safe.

The intended use of the new technology is when conditions require developing delicate, fast, safe and inexpensive decontamination methods. In these circumstances, non-thermal atmospheric pressure plasma created directly in liquids, gases, or on a surface, will be of particular interest. By applying non-thermal plasma a wide spectrum of ecologically safe particles are produced. These particles are free radicals O and OH, excited molecules of nitrogen and oxygen, ozone, ultraviolet radiation, etc. These particles destroy biologically dangerous pollutants, both pathogenic microorganisms and chemical toxicants.

Two new methods of atmospheric pressure cold plasma production were developed. These methods are original, simple in implementation, easily scalable and effective in their action on treated objects.

The first method for treating both hard and soft objects is based on a special discharge composed of many low intensive streamers, widely covering the surface of the treated object. This form of discharge provides effective treatment for objects at low energy density at the treated surface. This is a key for absence of local damages of the surface.

The second method assigned for treating liquid objects is based on a unique electric discharge in a liquid with gas bubbles. This discharge can be operated under specific conditions in a mode, which may be called “cold boiling”. In this mode, pre-existing large gas bubbles are broken up and form numerous small bubbles containing cold plasma.

Strong fining of gas bubbles and intense mixing them by the discharge provide high-efficiency transfer of active species produced by plasma from the bubbles to the liquid. Another merit of this method is insensitivity of the discharge in bubbles to the electric properties of liquids. This ensures versatility of the proposed method because in reality the electric properties of liquids to be treated vary over wide range.

Both cold plasma production procedures were tested in laboratory conditions. Complex microbiological objects were used in the tests and the results were promising. Experiments showed that discharge in liquid with gas bubbles and discharge at surface of a copper plate led to the death of 99.9% Bacillus sp. spores after treating for a few minutes. Additionally, cold plasma treatment killed vegetative cells of Pseudomonas sp., Escherichia coli, Bacillus subtilis and microorganisms of different physiological groups (sulfate reducing bacteria, aerobic heterotrophs) in model and natural biofilms. A widely spread surface discharge was successfully applied to cold treatment of thin polymer films without local damages.