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IN THIS ISSUE:	MESSAGE FROM NEIL B. GODICK
	Russia saw its economy shrink by 7.9% in 2009. Depending on the source, 2010 GDP growth ranges from -3% to +3.7% with the government predicting 3.1% growth. All agree growth is expected in 2011. Russia is the only BRIC country to experience negative GDP growth. As a result, foreign direct investment fell in 2009 by 75% compared to pre-crises levels. Foreign direct investment is not expected to reach previous levels until 2012 reports the Central Bank's statistics department. UNCTAD expects foreign direct investment in Russia to gain momentum in 2011 and rise. UNCTAD considers Russia one of the five most attractive nations for foreign direct investment. Russia is not likely to see its pre-crisis levels until 2013. Cyprus, home to a number of investment vehicles belonging to Russian firms or individuals, is Russia's largest investor. This distorts Russia's real foreign investment. Prime Minister Vladimir Putin has called on the government to create more favorable conditions for foreign investment. *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.*
Ceramic heat-resistant containers	Ceramic container products for chemical industry with high cyclic thermal load resistance were developed at I.V. Tananaev Institute of Chemistry and Technology of Rare-Earth Elements and Mineral Raw Materials (town of Apatity). These containers are based on layered ceramics with a Ta_2O_5 (Nb_2O_5) coating and a quartz base. They are treated with concentrated light fluxes (CLF). CLF treatment significantly affects tantalum pentaoxide's (Ta_2O_5) thermal expansion. After this treatment, the Ta_2O_5 thermal expansion curve

shows sections of zero, or sometimes negative, temperature linear expansion coefficients (TLEC), see fig.1.

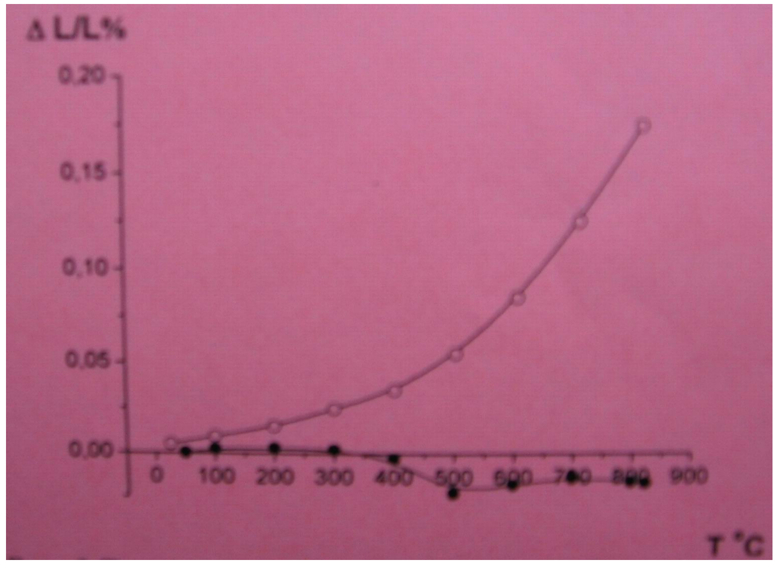


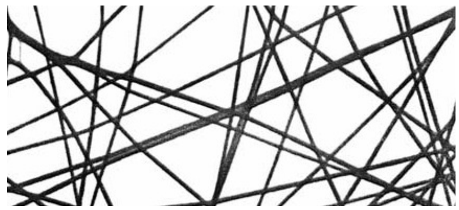
Fig.1. Temperature dependence of relative elongation of Ta_2O_5 ceramic samples:

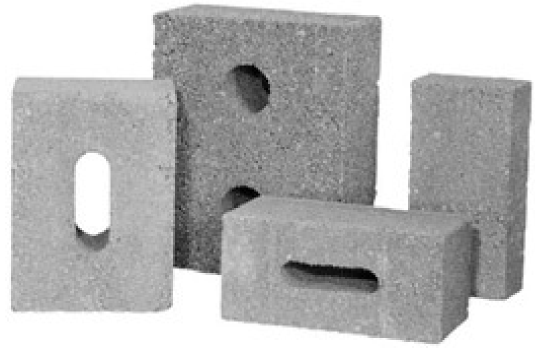
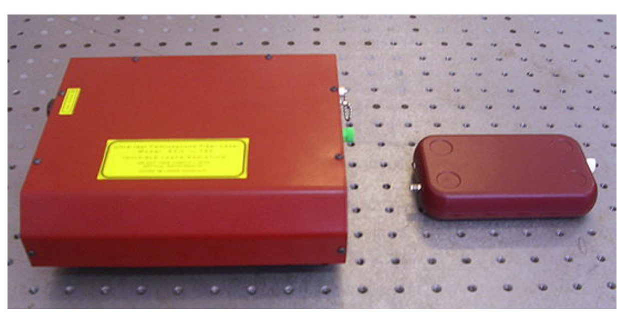
- ● Ta_2O_5 ceramic sample obtained in an optical with CLF action;
- ○ Ta_2O_5 ceramic sample obtained by typical ceramic technology.

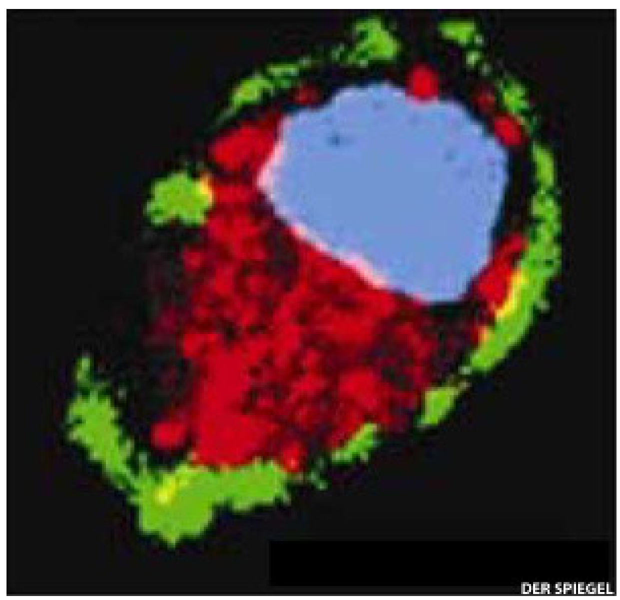
Complex nonequilibrium fractal-type micro and nanostructures result from the CLF treatment. The micro and nanostructures are 30– 50 μm in the tantalum pentaoxide.

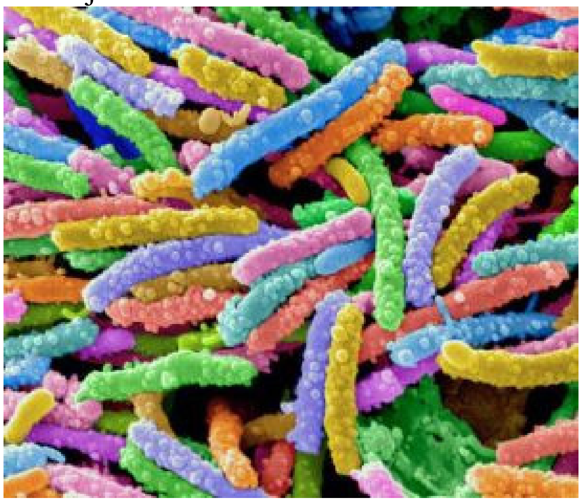
Products treated in this manner can stand thousands of quick heating-cooling cycles without damage (from room temperature to 1,000 °C). By assembling the quartz base from separate fragments cuvettes containers (volume: up to 1 liter) with a protective coating were produced.

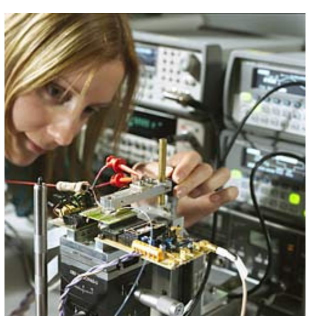
Fig.2. One-liter containers with covers

	The development's principal economic effect is the opportunity to replace platinum containers with layered ceramic containers. The latter cost about 25 times less than same capacity platinum containers. #2010-03-072
Filters for entrapment of nanoparticles	Scientists from the **L.Ya. Karpov Physicochemical Research Institute (Moscow)** develop filtration materials using electrospinning. The technique produces nonwoven polymer materials from fibers with diameters required for selected filtration.  Nanofibers (diameter: 0.12 µm) Nanotechnologies inevitably call for nanosafety techniques. Their basic principle is to prevent nanoparticles used in production processes from entering the environment. Workers at these production facilities must be protected from nanoparticles' harmful action. To optimize parameters for heat-resistant (operating at temperatures up to 300 °C) and chemically resistant nanoparticle entrapment filters, the Karpov scientists built a theoretical model for nanoparticles' interaction with polymer fibers. They found that the optimum filters for nanotechnologies should be assembled from nano and microsized fibers. The researchers modeled filters and tested them on model selenium nanoparticles (diameter: 100 nm). The selenium nanoparticles were used as they have the highest penetrability among nanoparticles. It was determined that the modeled filters retain 99.9999% of nanoparticles. The researchers set up a test-bench for nanofibrous materials. They developed methods to obtain test selected nanoparticles with 10-100 nm diameters. Specialists derived conditions for developing competitive filters from nanofibrous materials. These materials are suitable for protecting people and the environment, and determining nanoparticle presence. #2010-03-073
Nanomodified cement	Under **Igor L. Shkarupa's, PhD (Eng),** guidance the **Kaluga Regional Center for Nanoindustry (Obninsk)** has developed nanomodified cement with unique properties. The scientists developed special cement nanoadditives. They also developed a technology for using them to modify cement.

	 A new material with unique properties was obtained. It is quick-hardening and can withstand high temperatures. This cement is indispensable for blast-furnace production and strategic missile silos. This cement makes the silos multiuse, even though the fuel combustion temperature at launch is as high as 3,000 °C. It is also possible to use this nanocement for superheavy aircraft landing strips. #2010-03-074
Compact femtosecond laser	**Avesta-Proyekt Company's (Troitsky Techno-Park, FIAN, town of Troitsk)** researchers have developed a compact palm-size femtosecond fiber laser. Its simple design will help it become an economical alternative for ultra-short pulse research laser units. Femtosecond pulse lasers are used in physics, biology, medicine and other natural sciences. They also have practical applications in telecommunication equipment testing, multiphoton microscopy, parametric generation, optic frequency metrology, etc. Expensive titanium sapphire or chromium forsterite lasers requiring stable and powerful pumping systems are typically used in these applications. Avesta-Proyekt's laser pump and the entire electronics are built into a miniature housing. The laser's only requirement is electrical power. It can be used in complex systems (e.g., as a driving generator for amplification systems, or as a standalone pulse source for laboratory work.  Right: laser PErL (dimensions: 13.6 x 7.6 x 2.4 cm). Left: its predecessor EFO The Pulse Erbium Laser - "PErL" (pronounced "pearl") is a miniature

	unit. Its prototype is another femtosecond fiber laser - "EFO" (Erbium Fiber Oscillator). The developers miniaturized the system and simultaneously reduced its cost by using a new operating principle. The any laser's key element is a resonator. The resonator is used for positive feedback and, in its simplest version, consists of two mirrors. In "PErL", a saturable absorber deposited onto a semiconductor mirror and is used as one resonator mirror. The other mirror is an ordinary mirror. This arrangement requires minimal space. The laser operates in the 1530-1560 nm range, while the pulse duration can vary between 0.25 and 5 ns. The duration is determined by the user for a specific task. The laser radiation power can be as high as 50 mW, the pulse-repetition frequency being as high as 60 MHz. #2010-03-075
Multiuse nanocontainers for gas storage	**A.V. Vakhrushev and M.V. Suetin**, researchers from the **Institute of Applied Mechanics, RAS (Ural Branch), Izhevsk** are developing multiuse nanocontainers. One version operates under changing thermodynamic conditions. Under normal conditions they can preserve, without loss, hydrogen (1.6 mass%) absorbed under charging conditions (T = 77 K, P = 10 MPa).  Hydrogen from other nanocontainer types is released as the temperature increases. Nanocontainers with a charged fullerene locking element retain hydrogen irrespective of thermodynamic parameters. Only an external electrostatic field voltage determines absorption, storage, and release stages. Under normal ambient conditions, higher-capacity "bottle-shaped" nanocontainers with a charged locking element can retain 9 mass% methane adsorbed at 10 MPa and normal temperature. The authors have designed high-

	efficiency adsorbing nanocontainers for gas storage. To obtain complicated-structure nanocontainers (nanocapsules), current technologies for nanostructured carbon formation with radiation or particle flow exposure can be used. This technique changes carbon materials' structure, morphology and electronic, mechanical and chemical properties. Technologies were developed for making holes in nanotubes to an accuracy of 1 Å, change nanotube diameter, weld nanotubes to make, e.g. Y- and T-joints. These directed nanostructural change methods are the basis for developing nanocapsules with complicated structures. #2010-03-076
Luminescent bacteria to determine nanomaterials' toxicity	Specialists from the **Department of Biology, M.V. Lomonosov Moscow State University** designed simple and convenient tests to assess nanomaterial toxicity. Genetically modified *Escherichia coli* is used as the test subject.  Nanomaterials are everywhere. Carbon nanoparticles enter the air from methane, diesel and gasoline combustion. There is interest in using nanomaterials in biology and medicine. However a substance's nanoparticles could be more toxic than the substance in its ordinary state. At the same time, little is known about nanomaterials' effect on biological objects. The Moscow scientists found that carbon nanotubes are toxic for *Escherichia coli*. They used an *Escherichia coli* strain with a gene inserted from luminescent marine bacteria. The cell suspension was mixed with single-wall carbon nanotubes (particles 0.7 to 2 nm in diameter, and several µm long). The particles were synthesized using arc discharge at the Laboratory of Nanomaterial Spectroscopy, A.M. Prokhorov Institute of General Physics, RAS. The goal was to have one billion cells and 0.2 mg particles in a 1 ml

	aqueous suspension. The mixture was held at room temperature for different time periods. The cells were then washed to remove nanotubes and examined with an atomic-force microscope. After several days in water, *Escherichia coli* cells look like normal colibacilli. However, after 4 days' incubation with carbon nanotubes, the bacteria surface was deformed. The cell partially lost its content, and a gap in cell's middle could be seen. After 6-7 days, the cells are completely empty and the only thing remaining is a flattened cell wall. Nanotubes have bactericidal properties. After two days in incubation with them, the amount of live bacteria in the suspension was halved. After three days it was reduced by more than ten times. These structures mechanically destroy the bacterial cell wall and membrane under it. Carbon nanotubes cause external changes in bacteria and reduce their vitality. Carbon nanotubes also affect cellular metabolism. After an hour of joint incubation, bacteria double their oxygen consumption. However after two hours, it returns to normal. It is also convenient to determine the metabolism level by cell luminescence. After incubation with nanotubes, *Escherichia coli* with a marine photobacterium gene does not glow as brightly as it should. After just one day, the bioluminescence level is reduced by 45—50 %. The researchers found a direct relationship between cells' viability and their bioluminescence. It is easy to measure bacterial bioluminescence. Biochemical disturbance in *Escherichia coli* cells occurs much earlier than one can notice their external changes. When dried in a special way, luminescent bacteria can be stored for months. Luminescent bacteria can be used as a biotest to determine nanomaterial toxicity. #2010-03-077
Molecular biosensor for early cancer diagnosis	Scientists from the **Institute of Chemical Biology and Fundamental Medicine, RAS (Siberian Branch), Novosibirsk** have developed a molecular biosensor technology for early cancer and prenatal fetal genetic anomalies detection during pregnancy. The sensor is a silicon sieve whose through microchannels are arranged in a certain order and have preset shapes.  The larger cancerous cells are accumulated because they are larger. If a cancerous cell is present in the human bloodstream, it can be captured by the sensor and subjected to further analysis. This development is also useful for noninvasive fetal diagnosis. It is possible to determine, on the genetic and molecular-biological level, the presence of

	rare fetal cells. #2010-03-078