



# Nanotech ADVANTAGE ISRAEL <sup>TM</sup>

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*Israel is among the most fruitful producers of knowledge and innovation in advanced research and technology. Israel's tradition of academic excellence is widely known, and its high standing among countries producing leading edge applications in telecoms, semiconductors, IT and biotechnology has brought unprecedented profitability. Already a well-spring for nanotechnology, Israel is now becoming a world center for nanoscale product design and manufacturing.*

*We are pleased to include you among those who receive this newsletter. Your **feedback** is encouraged and appreciated.*

## In this Issue:

[TAU Nano Institute to Direct Joint Research Program for Europe's FP6](#)

[Nanotech and Europe's FP6 Program](#)

[Doing Business: ApNano Materials Produces the Ultimate Greaser](#)

[Technion NIBC Conference: Opportunities Abound, and So Do Challenges](#)

[Water on the Brain in Israel](#)

[Nano Business: VC Rebound? — R&D Fund Requests Up — US Global Nanospace Deal — More](#)

[Nano Briefs: Recent Research — Inaugurations — Conferences — More](#)

[Advisors and Resources](#)

[About Nanotech Advantage Israel](#)

[Previous Issues](#)

If you are having trouble viewing this document, please [click here](#) to view it on the web.

## TAU Institute to Direct Joint Research Program for FP6

[Return to Contents](#)

*Tel Aviv's interdisciplinary nanocenter has been selected for two pace-setting European nano-biotech programs.*

**TEL AVIV UNIVERSITY'S** interdisciplinary Research Institute for Nanoscience and Nanotechnology has won an influential role in the European Commission's nanotech R&D program, known as NanoMatProd (NMP).

The NMP effort is part of the huge Sixth Framework Program (FP6) for funding EC research projects in the area of nanotechnology and nanosciences, knowledge-based multifunctional materials and new production processes and devices. The EC has allocated 1.3 billion Euros to the NMP through 2006. The NMP is a broad-reaching program that specifically focuses on the transition from nanoscience to knowledge-based products and services, and on breakthroughs in new applicable knowledge (see [related article](#)).

The [TAU Institute](#), a budding young facility that is unique in Israel's research community, will receive funding of nearly 10 million Euros in order to support its participation in the NMP:

- The Institute will lead the effort to establish joint research priorities and policies for the NMP Nano2life Network of Excellence. The Nano2life Network will be comprised of about 24 separate EC research organizations, all of which are involved in nano-biotechnology work.
- The Institute will participate in development of a new generation of nano-biotechnology equipment, called CellPROMs. This NMP integrated project is intended to automate production of individually-programmed cells, using both man-made and natural techniques.

### **Nanotech and Europe's FP6 Program**



*FP6 funds  
can  
finance  
your R&D*

The European [Sixth Framework Program \(FP6\)](#) is one of the best financing vehicles for R&D activities today. The FP6 is an EC fund with an overall budget of 17.5 billion Euros for the years 2003-2006. Projects under FP6 are reimbursed for one-

### **Nano2life Network of Excellence**

The Nano2life Network will be built over four years, and is expected to encompass from 170 to 250 researchers. One express goal of the network is to keep Europe competitive with the US and Japan in nano-biotechnology, a task that presents a significant challenge to the historically diverse and fragmented EC research community.

The Institute was selected to lead the joint research program (Work Project 7 of Nano2life) not just because of its strong nano-bio research program, but because of its goals as an interdisciplinary organization, according to Dr. Ron Maron, Managing Director of the Institute.

"We bring our proven interdisciplinary experience to Nano2life," he said, referring to TAU's combined nanoscience research in medicine, microscopy, biosensors and electronics.

*"We bring our proven*

half (50 percent) of their overall R&D budgets.

The primary FP6 goals are to promote technology development in Europe, improve its competitiveness — especially as compared to the American and the far-east technology markets — and enhance welfare policies (employment, gender equality, and the like).

The FP6 budget is based on the contribution of all participating countries, including all the EC member states, candidate countries and associated countries, like Israel. Each country contributes according to its population size and gross domestic product (GDP). Israel's contribution for years 2003-2006 amounts to 200 million Euros. This contribution entitles any Israeli R&D entity to fully participate in the FP6 program, like any other European country.

Europe's Framework Program has been a success story for 20 years now (each program runs 4 years in length). One way to measure the success of the program is by reviewing the list of the program participants throughout the years. Most European companies — large and small — as well as most universities are taking part in FP6 projects.

### ***What are the Benefits of FP6?***

The FP6 program offers many benefits to participating Israeli companies:

- Currently, the FP6 program provides support for Israeli R&D projects without any ceiling (unlike programs offered by the Israeli Office of the Chief Scientist). The FP6 contribution is flat, and fixed at 50 percent of the R&D budget. Salaries and other direct expenses with at least

*interdisciplinary experience to Nano2life."*

*Dr. Ron Maron, Institute Managing Director*

As an example, Maron cites the Institute's success in providing the infrastructure and expertise necessary to perform microscopy at both cell and atomic levels — two entirely distinct areas of characterization. The interdisciplinary nature of the Institute enables TAU researchers from life sciences to study cell structures alongside researchers from engineering who are assembling bio-chips, and provides unique opportunities for collaboration.

"That is part of our charm for the NMP," Maron commented. "We maintain very close ties between life sciences, engineering and physics." The Nano2life steering committee agreed. The Institute's joint research program proposal was chosen from a field of 11 finalists.

As lead organization in the joint research program, the Institute will direct efforts to prioritize research and technologies that closely match the expertise and capabilities of all Nano2life participants. The Institute will then use this knowledge to initiate new Nano2life projects that provide solutions to current problems in research.

TAU researchers will be also be joined by several scientists from the Hebrew University and Ben-Gurion University for the Nano2life project.

The FP6 has allocated approximately 8 million Euros to TAU to fund its activities in the Nano2life Network.

### ***CellPROM***

The CellPROM integrated project will also take place over four years, bringing together 37 universities, research institutions and private companies. The NMP designates its integrated projects as breakthrough-driven and innovative.

*"We're contributing our knowledge and capabilities in biochips and deposition of stem cells."*

*Prof. Yosi Shacham-Diamand, Institute Director*

Unlike Nano2life (whose objective is to create a long-term nano-bio network for research collaboration), CellPROM has as an ambitious objective: the creation of a new class of

20 percent overhead are recognized, including travel, administration and knowledge dissemination.

- FP6 project scope can vary from 18 months up to five years, depending on the financing instrument used. Again, unlike programs of the Chief Scientist which are limited to one year and require renewal every year, with FP6 you need to submit once for each project, regardless of its length.
- The object of the FP6 is to create positive cash flow for a project at its beginning. As a result, at the beginning of each year, the EC transfers 85 percent of that year's FP6 contribution. The remaining 15 percent is transferred by the end of each year, provided that all required reports are submitted.
- No royalties are taken on FP6 grants, and no intellectual property rights (IPR) restrictions applied by the EC on products or applications resulting from the project. The EC policy is only to ensure that all project participants are in agreement regarding IPR issues.
- Participating in FP6 opens the doors to the European market, one of the best added values of the program. Many business alliances started in FP projects.

**The Nanotechnology Opportunity**

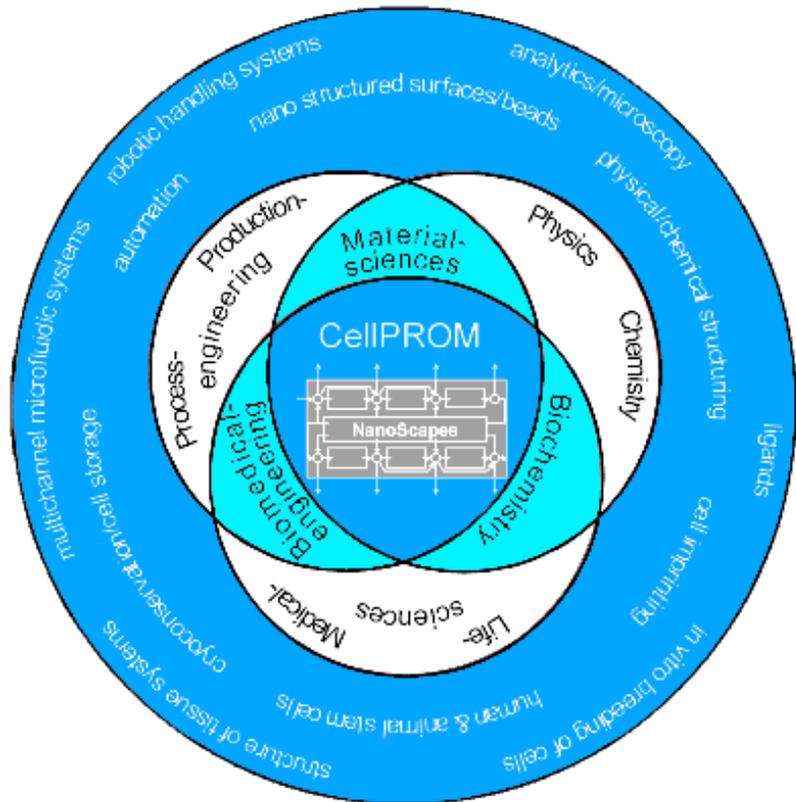
Currently, there is a very attractive window of opportunity for companies seeking EC funding for nanotechnology R&D.

The EC has long embraced nanotechnology as an innovative

production equipment that will "revolutionize existing handling technologies and procedures" for large numbers of cellular samples. Specifically, CellPROM calls for development of procedures and devices that are capable of creating "individually tailored, nanoscale macromolecular landscapes which will allow us, for the first time, to non-invasively produce well-defined populations of individually programmed cells, eventually leading to substantial breakthroughs and numerous applications in the fields of molecular medicine and cellular nano-biotechnology."

Targets for these "nanoscapes" will typically be animal and adult stem cells. (The project plan explicitly prohibits the use of human embryonic stem cells.) Target cell surfaces will be imprinted using various nanotechnology techniques, so as to control and direct the target cell's ability to differentiate into new or altered forms.

CellPROMs can be compared with high throughput automated cell screening devices, which first came into use a decade ago. However, CellPROMs will move beyond passive screening, and will perform active manipulation of the cell.



CellPROM's Integrated Project vision

research area. Recognizing its importance to Europe's current competitiveness, FP6 has allocated 1.3 billion Euros to its [NMP](#) program through 2006.

*Continued below*

The CellPROM project is led by the German Fraunhofer-Gesellschaft, a Munich-based, non-profit applied research and development institute. Other participants include the EPFL Center of Micro-Nano-Technology (Lausanne), KTH-Royal Institute of Technology (Stockholm), Centre for Research in Nanobioengineering, University of Barcelona (Barcelona) Institut Pasteur (Paris), and industrial partners such as EVOTEC Technologies GmbH (Hamburg), SkinEthic Laboratories (Nice), Eurogentec (Seraing), and SILEX (Kista).

"We're primarily contributing our knowledge and capabilities in biochips and deposition of stem cells," says Prof. Yosi Shacham-Diamand, Director of the TAU Institute.

Once again, the Institute has benefited greatly from its interdisciplinary approach. "A colleague from Germany called to ask that we be partners, because of our broad experience in engineering, life sciences, biosensors and nanosciences," Shacham-Diamand notes.

The Institute will participate in three CellPROM workgroups: Nanoscapes (that is, nano-imprinting), Storage/Usage, and Innovation Activities.

The FP6 has allocated approximately 1.6 million Euros to TAU to fund its activities in the CellPROM integrated project.

### ***About the TAU Nanoscience and Nanotech Research Institute***

Established in 2000, the TAU Research Institute for Nanoscience and Nanotechnology has brought together the knowledge and efforts of Engineering, Exact Sciences, Life Sciences and Medicine faculties at TAU on more than 85 projects. The TAU Institute is unique — both in Israel and abroad — in its successful research over multiple disciplines.

It would be difficult for a casual visitor to be impressed by the existing facilities of the Institute, which are located in the basement of TAU's Exact Sciences Library. Currently, renovations are being made to these facilities in order to create central clean room and lab space, as well as smaller labs for use by Institute faculty. But a glance at the state-of-the-art equipment currently managed by Institute in various locations on the TAU campus will quickly allay any skepticism about the Institute's capabilities. For example, the arrival of a new ultra-high vacuum scanning tunneling microscope (STM) is imminent.

The Institute intends to unify all of its scattered resources into the 1300 square meter location to provide central user-oriented characterization facilities, as well as additional lab space for visiting scientists and graduate students.

Institute Director Shacham-Diamand, an accomplished and respected researcher in electrical engineering and nanoelectronic process technology, has created a strongly multi-disciplinary facility. Until now, such a facility was a peculiar phenomenon in Israel; other local institutions — like the Weizmann Institute and the Technion — have established their reputations as highly-focused, single discipline research centers.

But nanoscience and nanotechnology, by nature, demand an interdisciplinary approach, as Shacham-Diamand enthusiastically attests. He has purposefully modeled the Institute on the remarkable success of [Cornell University's Nanoscale Facility](#), where he has also conducted research since 1989. The Cornell facility

was among the first to apply nanotechnology research to disciplines such as the life sciences.

*"It's not easy this way. We are different from the historical trend in Israel."*

*Dr. Ron Maron, Institute Managing Director*

In addition to the FP6 and other scientific research, the Institute is collaborating with companies from various industries on interdisciplinary projects of commercial interest. Among firms with working ties to the Institute are Fiat, Intel, Tower Semiconductors, Clal Biotechnology Industries and Teva Pharmaceuticals.

Managing Director Maron cites the Institute's interdisciplinary approach as its most promising feature. "It's not easy this way," Maron acknowledges. "We are different from the historical trend in Israel." But he adds, the success with the EC's Nano2life and CellPROM projects is a good indicator of the Institute's future. "The NMP goals combine beautifully with our own mission. Being interdisciplinary enables us to connect with research projects being performed in nearly every location. It's very elegant."

Along with ensuring Israel's place on the leading edge of nano-biotechnology R&D, the Institute's NMP activities will create fresh new opportunities for Israeli researchers to collaborate with European academic and industrial institutions. That brings two-fold benefits, Maron points out. "Knowing about what other groups are doing will help us to better focus our activities here. At the same time, the program enables us to use the experience and expertise of foreign groups — for example, a transmission electron microscope (TEM) operator in Spain might come here who can teach us TEM techniques that are different from those we know today."

## **Doing Business: The Ultimate Greaser**

[Return to Contents](#)

*No fancy sci-fi story here: Rehovot's ApNano Materials has picked the classic low-hanging fruit for its proprietary process.*

**ENTHUSIASM IS AN** abundant commodity today when it comes to selling nanotech. But not savvy. NanoLub, the flagship product of the Israeli startup [ApNano Materials](#), is all about [savvy](#).

At a time when most eyes seem to be on nanotech's most speculative applications — man-made self-replicating molecules, medical nano-robots, and other inventions that will take decades of additional research to develop — NanoLub enters the market on one of the most mundane levels imaginable: lubricants.

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*ApNano Material's more exotic inorganic nanotubes are also gaining recognition. See [related article](#).*

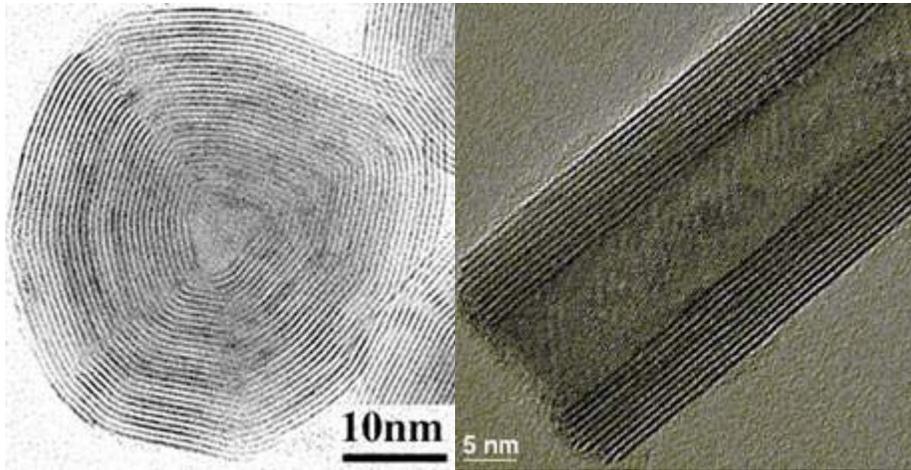
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[NanoLub](#) is billed as the world's first commercial solid lubricant to be based on spherical inorganic

nanoparticles. As with other lubricants, its job is to reduce wear and friction between moving objects, enabling longer operation and higher efficiency.

### ***Why Its Better***

The advantage of NanoLub over other common solid lubricants is expressed in the description "spherical inorganic nanoparticles." First, their spherical nature provides significant benefits over other forms of solid compounds used for lubrication, such as molybdenum disulfide (MoS<sub>2</sub>), and tungsten disulfide (WS<sub>2</sub>). Conventionally, when used as lubricants these materials take the form of layered platelets, whose size and shape actually cause them to heat up and break down over time and lose their lubrication qualities. NanoLub spheres are composed of the same materials, but they are round and hollow. This structure enables them to roll over one another — like miniature ball bearings — staying cooler and maintaining their function. Second, their nano size makes them able to find their way into tinier places and reduces their agglomeration, resulting in dramatically increased coverage, even on rough surfaces. Third, as inorganic material, NanoLub performs beautifully even in extremely harsh environments.



ApNano Material's proprietary inorganic fullerene (left) and proprietary inorganic nanotube (right)

NanoLub's marketers have shown that it can even improve lubrication efficiency for roughly-finished parts and surfaces. This means that manufacturers can spend less time and money in machining their parts. On the environmental side, using NanoLub reduces energy consumption and can decrease air pollution. Finally, NanoLub can be used as an additive, as an impregnated material, as a component in polymer or metal composites, or simply as a powder.

*Their structure enables them to roll over one another — like miniature ball bearings — staying cooler and maintaining their function.*

ApNano Materials is promoting NanoLub for application in maintenance-free systems, aerospace, medical and marine industries, ultra-clean manufacturing environments, and in heavy machinery such as power plant turbines.

Perhaps the most interesting prospect that arises from commercialization of NanoLub is the possibility that we will no longer need to change the oil in our automobiles — ever. Considering that heat and wear are

among the primary causes of engine and transmission failure today, NanoLub may even raise the future reliability of these components to that of today's semiconductor chips.

## ***Huge World Market***

Mundane they may be, but the fact is that lubricants are a huge world market. Dr. Niles Fleischer, Vice President of Business Development for ApNano Materials, reports that the annual market for oils and grease is \$40 billion and growing; the annual market for additives is \$7 billion and growing. NanoLub is a very compelling new product for these markets — the first to provide such performance advantages. Now that's savvy.

Among those who have already recognized the potential for NanoLub is German automaker Volkswagen, who revealed recently that they are working with ApNano Materials to develop advanced lubrication solutions for their combustion engines. In one report, the giant VW wrote that "based on results already achieved in the lab, these nanospheres promise to be more stable with higher performance and longer lifetime; additionally, a very low coefficient of friction, even at high loads, can be achieved."

Fleischer and the company's CEO, Dr. Menachem Genut, acknowledge VW's interest, as well as that of other leading lubricant manufacturers, automakers and aircraft firms.

While NanoLub is admittedly a handsome piece of low-hanging fruit (as speculative investors would say), it is not a simple matter to break into a traditional conservative market such as lubricants.

"Yes, and that's exactly the point," Fleischer says. "It's a relatively conservative market, with few innovations in recent years. But now, with all the green market trends — the demands of environmentalists, the need to extend fuel mileage — we're bringing them a very painless way to make the change."

Chairman and CFO Aharon Feuerstein adds, "The industry doesn't have the infrastructure to come up with the new developments which are demanded. That's our business card entry into this. We're the breath of fresh air in this market that more established companies can't provide."

ApNano Materials divides the market into three main sectors: large lubrication manufacturers and base oil companies who also do their own formulating; large end users like automotive companies; and the vast array of firms that manufacture additives. Of the three sectors, Fleischer says that the additive companies have been the least interested in the ApNano Materials solution. "That's because while the large manufacturers and large end users are seeking to extend their reach to greener products, the additive companies are buffered from all that."

*That's exactly the point. With all the green market trends, we're bringing them a very painless way to make the change."*

*Niles Fleischer, VP Business Development*

Of course, another way to view this observation is that additive companies have the most to lose from the introduction of NanoLub,

## ***Not by Lubricants Alone***

NanoLub may be the first commercial product of ApNano Materials, but likely not the last. The company has already announced its intention to manufacture inorganic nanotubes, a product also based on the processes developed by Prof. Tenne and colleagues at the Weizmann Institute.

Today, **nanotubes** come in two varieties: organic and inorganic. While academic and industrial researchers have been working with the organic, carbon-based variety for over a decade, successful applications for them are proving elusive. However, their inorganic cousins —

which by itself might potentially be considered a disruptive technology for that sector.

### **Proprietary, Patented Process**

CEO Genut is among the co-discoverers of **inorganic fullerene structures** — the basic building block of NanoLub — along with Prof. Reshef Tenne, Dr. Lev Margulis, and Dr. Gary Hodes. Tenne, who led the research into the discovery of inorganic fullerenes, heads the Nanomaterials Synthesis group at the **Weizmann Institute**, and also acts as an advisor to ApNano Materials. The structures studied by Tenne and his colleagues are similar to the organic, **carbon-based fullerenes** discovered in the mid-1980s, but they exhibit some important advantages. They are less reactive with other materials, more flexible under stress, more stable and even more shock-resistant than their carbon-based cousins. Some technology analysts have even begun to question the usefulness of carbon-based fullerenes (see **related article**), in light of their shortcomings and the discovery of inorganic structures. ApNano Materials is the biggest potential beneficiary of such skepticism, as it holds key patents on the processes for producing inorganic fullerenes.

These patents are owned by **Yeda Research and Development**, the technology transfer arm of Weizmann Institute, and are licensed exclusively to ApNano Materials. The company was created in 2002, and is owned jointly by its founders, Yeda Research and Development, AYYT Technological Applications (the technology transfer arm of the Holon Academic Institute of Technology) and **Newton Technology** VC fund.

### **Investors Take Note**

ApNano Materials maintains marketing and sales offices in New York, with research and development facilities in the high tech industry park neighboring the Weizmann Institute in Rehovot. Fleischer says the company is currently surveying Israel, the US and other countries for a place to build its full-scale production facilities.

Currently, the company is able to produce about 1 kg of NanoLub per day, enough to provide samples for industrial testing. Fleischer says that semi-commercial quantities (about 100 kg per day) will be in production within 18 months, and that factory level commercialization is expected within three years. Fleischer expects NanoLub to generate revenues of more than a \$100 million in its early stages of production.

"We're now raising additional capital to get our pilot facility up and running," Fleischer says. That semi-commercial facility will be located in Israel. The company is currently seeking investments totaling \$4 million. Financing is only one criterion for a commercial plant, the others being its proximity both to major customers and the needed raw materials. Fleischer says the company is also considering

discovered subsequently by Prof. Tenne and his Nanomaterials Synthesis group — by contrast have shown immediate viability. It already appears that inorganic nanotubes are superior for many commercial applications.

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In its **October issue**, the Economist highlighted the growing skepticism surrounding organic nanotubes, and by contrast, the optimism gathering for inorganic ones. As their discoverer, the Economist quoted Tenne extensively.

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That makes the proprietary processes for simpler and less expensive production of the inorganic variety, developed by Tenne, et al, worth a bundle.

Among the target applications ApNano Materials claims for their inorganic nanotubes are:

- **High resolution flat panel displays.**  
Nanotubes are a prime candidate for use in this fast growing market. ApNano Materials says it has developed inorganic nanotubes that have better electrical properties than carbon nanotubes.
- **Atomic force microscopes (AFMs).**  
Inorganic nanotubes can be used as probing tips in these important research instruments. ApNano Materials says that the high aspect ratio, chemical inertness and high strength of their inorganic nanotubes make them ideal for probing nanoscale structures.
- **Composite materials.**  
Inorganic nanotubes will likely enhance and

strategic industrial partnerships.

According to Fleischer, the company is investing resources both into its flagship product NanoLub, as well as into development of additional applications for inorganic fullerene structures. (see [related article](#))

Does CFO Feuerstein see NanoLub as the company's lucrative cash cow? "Not necessarily. We're still forging our strategy at this point. NanoLub is our most mature product, but we have the inorganic nanotube applications in the pipeline, which may eventually prove much more lucrative. But today our main focus is on NanoLub."

Now is that savvy, or is that savvy?

supplant today's vast market for additives to composite materials for conductive plastics, reinforced fibers and polymers, and reinforced ceramics used in personnel safety equipment, vehicle reinforcement, and electronics.

The company values the potential market for inorganic nanotubes at billions of dollars by 2010.

## **NIBC: Opportunities Abound, and So Do Challenges**

[Return to Contents](#)

*Exploring new business models to meet the next industrial revolution.*

**C**ONVERGING TECHNOLOGIES are rapidly changing the way we do business, as well as the way we do research. That was the key message at the Nanotechnology, Information Technology, Biotechnology, Cognitive Science (NIBC) Conference held on January 15 at the S. Neaman Institute in Haifa, "New Opportunities in Converging Technologies".

Nearly 200 attendees, representing Israeli industry, academia and investment firms, heard presentations by executives from companies like Intel, Motorola, Compugen, and Teva, as well as from institutions like MIT, Northwestern University and Worcester Polytechnic Institute. The conference was organized and sponsored by the [Technion Institute for Management \(TIM\)](#), the [S. Neaman Institute](#) for Advanced Studies in Science and Technology, and the Technion.

"We were very pleased with the turnout," says by Shlomo Maital, Academic Director of TIM and professor of Management and Economics at the Technion. "The conference actually began as business-science-technology conference, but other Israeli conferences in recent months have used the same theme, so we decided to reposition the conference on the question 'Where's the business?'"

Speakers focused on the challenges that industries face when attempting to develop products and commercialize in a period of convergence. Maital summarizes, "With nanotech and convergence, the old business models don't work anymore." Maital points explicitly to the information technology boom, saying that the success stories of the last twenty years will not suffice in a time of convergence. "Now, if you want to make a great product, you not only need business skills, you must understand all these different technologies and weld them together."

*"You not only need business skills, you must understand all these different technologies and weld them together."*

*Shlomo Maital, Academic Director of TIM*

The conference organizers purposefully enabled participants to mingle over breaks and lunch, in order to help spark business interest. While the morning session was dominated by US interests, the afternoon session showcased Israeli interests, and included product introductions by executives from eight convergence-oriented firms: Yotam Levine of [NanoPass](#), Ariel Notcovitch of [Proteoptics](#), Zvia Agur of [Optimata](#), Ilan Weitzman of [3DV](#), Tal Bresler of GeneGraft, Andrew Pearlman of Vascular [Biogenics](#), Ory Zik of [QuantomiX](#), and Jeff Dykan of [Vitalife VC](#)

TIM has put some of the [NIBC conference materials online](#).

At the wrap-up session, the primary question was 'Where do we go next?' To answer that question, TIM is now engaged in setting up an informal network for NIBC and convergence information in Israel. For more details, contact [Tal Lipovetzki](#), Operations Director and TEF Program Director at TIM.

***Related Links:***

[Technion Institute of Management \(TIM\) Article: The Next Big Thing](#)

## **Water on the Brain in Israel**

[Return to Contents](#)

*Leading nano researchers from Israel and the world assemble to ask the 'why nots' of clean water.*

**I**SRAEL'S NANOTECHNOLOGY program got a serious boost in December, with the first meeting of stakeholders in the Nanotechnology Clean Water Initiative. The Initiative — fruit of combined efforts by Dr. Uri Sagman, Prof. Samuel Pohoryles and former Prime Minister Shimon Peres — has brought together major Israeli university researchers and global industry principals for the first time to work on nanotech-based solutions to the water shortage in the Middle East.

The one-day forum took place at the [Weizmann Institute](#) in Rehovot, and included researchers from Weizmann, the Technion, [Bar-Ilan University](#), [Ben-Gurion University](#) and the [Hebrew University](#), executives from [Luna Innovations](#) of Virginia, from the [Canadian NanoBusiness Alliance](#) and European consulting firm [Cientifica](#), as well as from the [Andreas Agricultural Development Trust](#), an arm of the Peres Center for Peace.

From all reports, the Forum was a complete success, igniting practical interest among all its participants, and moving one step closer to Nobel Laureate Peres' vision of Israel as a world leader in nanoscience-based clean water technologies.

"Our primary objective now is to develop the roadmap," Sagman reported in a telephone conversation this month from his home in Canada. "Part of that process is meeting with all the individual groups in a determined way to develop a plan, support, funding and interaction with industry."

Sagman has spearheaded the project, whose stated intention is to dedicate experts and resources "to the deployment of nanotechnology to solve water stress problems and to provide development of novel technologies that address water stress."

A noted physician, scientist and entrepreneur, Sagman is Executive Director of the Canadian NanoBusiness Alliance and is also President and co-founder of **CSixty**, a company that is pioneering the development of organic fullerenes for use in biopharmaceutical applications.

Sagman announced formation of the Nanotechnology Clean Water Initiative in November, **during an appearance** at the World Nano-Economic Congress in London.

Pohoryles, Director of the Andreas Agricultural Development Trust and a key project organizer, was also encouraged by the inaugural meeting and the progress made so far. "We've created an inter-university framework with an emphasis on each university's specialization in nanotechnology," Pohoryles reports.

It is hoped that the Water Initiative will result in practical new knowledge that can reduce the cost of water desalination and purification. To start, the current participants have focused on research projects that can improve existing processes (for example, conventional reverse osmosis), but also intend to strike out in search of new processes.

*"We've created an inter-university framework with an emphasis on each university's specialization in nanotechnology."*

*Samuel Pohoryles, Director, Andreas Trust*

The preliminary plan, used as the basis for discussion at the inaugural forum, proposes a joint research program comprised of five separate tracks and 17 projects, conducted by some 20 researchers Israeli institutions. The initial cost for the program was set at just over US \$5 million for its first three years.

In particular, the participants envision nanotechnology as a powerful toolset that will enable creation of:

- nanoscale filtration membranes to allow increased recovery in existing systems;
- environmentally-friendly, in situ methods for reduction of groundwater pollution by organic as well as inorganic elements;
- nanosized materials to improve the efficiency of photocatalytic and chemical processes underlying solar energy production, resulting in higher heat and pressure yields; and
- nano-biosensor development, enabling faster and more complete reporting on contaminants.

Another critical objective of the Initiative, according to Pohoryles, is to dramatically increase Israel's available research capacity. Pohoryles believes that expanding the number of Israeli researchers devoted to water research will spawn solutions for generations to come.

The Initiative is also creating an opportunity to build, potentially, the largest joint research project ever undertaken in Israel. With participation of all major research institutions already in hand, organizers now need to fashion suitable methods for managing and applying the outpouring knowledge that will result.

One participant in the Initiative notes that the December meeting has already generated follow-on activity among the Israeli institutions that would not have occurred otherwise. "Water research is a very good thing to coalesce around," he says. Among other benefits of a concerted research effort, he adds, are the broader relationships that result with industry, as well as incidental spin-off projects. "Look at what happened with Velcro, which was really just a small bi-product of the US space program."

*"Water research is a very good thing to coalesce around. Look at what happened with Velcro, which was really just a small bi-product of the US space program."*

*Clean Water Forum Participant*

Certainly that is one reason why Luna Innovations, Inc. — an innovative, multi-disciplinary industrial R&D house located in Virginia — has already joined the Initiative as an industrial partner. Luna brought four of its top scientists to Weizmann for the initial meeting, all of them involved in nanotechnology. According to Pohoryles and others, Luna will have first rights to commercialize any findings or applications resulting from the Initiative.

Both Pohoryles and Sagman acknowledge that other industrial sponsors are expressing interest in the Initiative, along with private funding organizations.

But all parties, organizers and research participants alike, exercise great caution when talking about the future of the Nanotechnology Clean Water Initiative. Though optimism certainly prevails, Sagman is advocating a quiet approach. "We want to make sure that we have a consensus before going forward," he says.

Potential partners and stakeholders are invited to contact the [Andreas Agricultural Development Trust](#).

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Afterward: Tim Harper, founder of CMP Cientifica and Executive Director of the European NanoBusiness Association, was one of the participants in the December meeting at Weizmann. He provided a personal perspective on Israel's Nanotechnology Clean Water Initiative in his year-end column for [Nanotechweb](#).

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## **Nano Business**

[Return to Contents](#)

### ▪ ***IVC Reports 20% Increase in Israeli Venture Capital Raised***

The [Israel Venture Capital \(IVC\)](#) Research Center has confirmed the hunches of many, that in the fourth quarter of 2003, Israeli high-tech firms raised US \$246 million — 20 percent above the \$205 million raised in the same quarter of 2002 (see [chart](#)). The 2003 sum represents 96 companies, with 50 companies attracting more than \$1 million each.

During 2003, just over \$1 billion was raised from venture investors, both Israeli and foreign. This amount is 11 percent below the \$1.138 billion raised in 2002, but approximates the levels reached in 1999, when venture investments began to increase dramatically. In addition, more companies are represented in the 2003 rounds than either the 2002 or 1999 rounds.

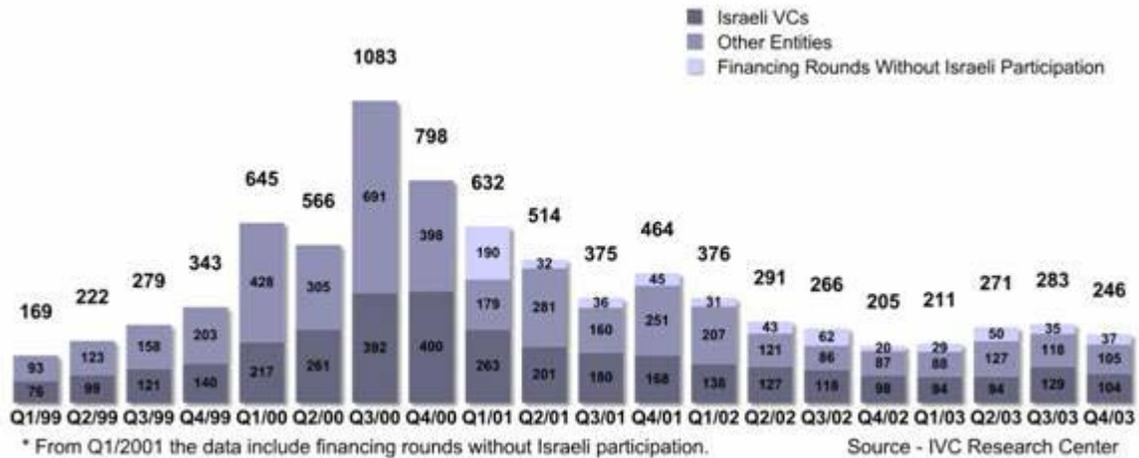
In the fourth quarter of 2003, the Life Sciences sector showed the largest jump in capital raised, with a 180 percent increase to \$64 million from \$28 million in Q3, while returning to year-earlier capital raising levels.

## Nanotech Advantage Israel – January 2004

"We foresee an increase in the pace of technology investments in light of the more buoyant capital markets in Israel and abroad," says Zeev Holtzman, Chairman of IVC Research. Holtzman sees a race developing among the top ten Israeli VC firms, which will likely result in their raising \$1 billion in 2004, just amongst themselves. The IVC study reflects contributions from a total of 125 VC firms.

*Since 2002, Israeli nanotech firms have raised \$2.5 million in venture capital.*

Efrat Zikri, Director of Research for IVC, reports that since 2002, Israeli nanotechnology-related firms have raised a total of \$2.5 million in venture capital.



IVC conducts quarterly surveys in cooperation with the [Israel Venture Association \(IVA\)](#), and maintains a database of over 4,000 Israeli high-tech companies, VC funds, investment companies and technology incubators.

- **R&D Funding Requests from Chief Scientist Up 33%**

Eli Opper, Israel's Chief Scientist, reported in December that total funding requests for 2004 exceed US \$2 billion, up 33 percent from 2003. These numbers represent 33 companies and 219 requests. The Office of the Chief Scientist is part of Israel's Ministry of Industry and Trade, and is responsible for supporting early-stage technology research to boost Israeli industrial capabilities. A response by the Israeli government to address the increased requests for subsidies is expected in the coming year, in spite of severe budget constraints.

- **Small Times: Far East Report Predicts \$18 Billion Nano Market by 2005**

In December, the leading US small tech monthly [Small Times](#) reported findings from the Far East that forecast a global nanotechnology market of US \$18 billion by 2005.

The publication cited a survey that was conducted by the Japanese business information service [Nihon Keizai Shimbun](#) and published in Asia Pulse. The survey found 40 companies that are currently developing nanotubes and other nanomaterials globally, and expect to release products in one to three years. Among these first commercial products are carbon nanotube-enabled flat panel displays

and fuel cells. Other products now on the production line include nano-based glass and fibers, high-capacity memory and environmental cleaning systems.

The survey reflects 240 firms in all business stages, Small Times reported.

- ***NY Times: Don't Look Now, But Here Come the Nano VCs***

In its [report](#) on the NanoCommerce trade show held in Chicago in mid-December, the New York Times said that leading US entrepreneurs are already feeling the heat of venture capital interest since passage of the Congressional bill that provides a record \$3.7 billion in national funding for research.

Industry figures were generally characterized as being cautious, but many were also quoted saying that the 'takeoff' point is imminent for funneling speculative capital into nanotech industries. The VC firms that are most active in generating interest in US nanotech were also featured — [Lux Capital](#), [Draper Fisher Jurvetson](#), and [Harris & Harris](#) .

- ***Israeli Cyclone, US Global Nanospace Sign Production Agreement***

Cyclone Aviation Products of Karmiel has struck a deal with US Global Nanospace (USGN) of Nevada to manufacture USGN's S.A.G. Humvee turret. An initial order for 20 turrets has already been placed.

The [S.A.G. Turret](#) is a lightweight shielded turret designed specifically for the US military's High-Mobility Multipurpose Wheeled Vehicle (HMMWV, pronounced Humvee). Weighing less than 200 pounds, it allows rapid rotation, thus protecting personnel more effectively in battle, and enabling quicker response time. The turret is composed mainly of USGN's proprietary G-Lam nano-fiber, a material proven to outperform the ceramic faceplates used in conventional composite systems. G-Lam is also impervious to petroleum distillates and maintains performance at temperatures in excess of 400 degrees Fahrenheit. According to the agreement, the manufactured turrets will be used for protection against ballistic threats of up to .50 caliber and will made be available to allied countries with U.S. government approval.

[US Global Nanospace](#) is an applied nanotechnology company focused on developing products for commercial and defense applications. [Cyclone Aviation Products](#), a subsidiary of Elbit Systems Ltd., designs and produces composite and metal structural parts for civil and military aircraft.

## **Nano Briefs**

[Return to Contents](#)

- ***Technion Team Creates First Self-Assembling Nanotube Transistor Using DNA***

Perhaps the single most impressive nanotech research finding of 2003 was creation of the first working electronic transistor from a [nanotube](#) using the biological self-assembly function that is inherent to DNA. This achievement will have major significance for every product based on semiconductors, bar none.

The Technion research team, led by physicist Erez Braun, published their breakthrough in the journal [Science](#) on 21 November, and has since presented its findings at several conferences. In his review

of their work at the first [ISBIE conference](#), research team member Uri Sivan described the breakthrough as "extending biology so that it will be able to assemble microelectronic circuits for us." Sivan emphasized that manufacturing transistors using this technique is only in its "baby steps." He added, "This is not a Pentium 5. What we ended up with was the lousiest p-type transistor I've ever seen. But it works."

The work has been hailed as nothing less than "outstanding" and "spectacular" by experts at Columbia University and Delft University in the Netherlands. The Technion research team is comprised of [Erez Braun](#), Rotem Berman, Kineert Keren and Uri Sivan. Coverage: [New Scientist](#), [Nanotechweb](#), [Israel21c](#), [Eureka](#).

▪ ***BGU Nanocenter: New EM Unit, French Bi-National Conference, and Bio-enzyme Lithography***

Ben-Gurion University's [Ilse Katz Center for Meso and Nanoscale Science](#) formally opened its Electron Microscopy (EM) laboratory with a one-day workshop entitled "Advanced Analytical Techniques in Electron Microscopy" on 21 January. The workshop was sponsored by Thermo Electron BV, AVBA Engineers Ltd., and the Israeli Society for Microscopy.

Recent acquisitions are part of an impressive development plan for the BGU nanocenter in Beersheva, which includes a dedicated 1900 square meter building. Nanotech Advantage Israel will feature complete details on the BGU nanocenter in a forthcoming issue.

The EM lab opening follows on BGU's highly successful five day Bi-National France-Israel Workshop on [Biosensors, Biochips and Nano-biotechnology](#) held in December. This third annual symposium was hosted by BGU's [Institute for Applied Biosciences \(IAB\)](#) and sponsored by BGU, the French Ministry of Foreign Affairs, and the Israeli Ministry of Science and Technology. It brought many dozens of nano and biotech researchers together for seminars that took place on the Beersheva campus as well as in Israel's southern-most Red Sea resort city of Eilat. Among the attendees were 15 leading French researchers, two Jordanian scientists, and participants from the US, Finland and Czechoslovakia. Attendees included industrial as well as academic representatives. The workshop included detailed discussions on the [Program for French-Israeli Technological Cooperation](#), dedicated to advancing collaborations between R&D and industrial organizations in both countries.

All of the above is in addition to the recent publication in [Nano Letters](#) of pioneering research led by Dr. Levi Gheber of the IAB, that uses a biological enzyme to perform negative nanolithography (that is, lithography where material is removed rather than added to a surface in order to produce useful features). This pure biological technique offers great potential for developing natural, protein-based biosensors and biochips, since it results in a surface that is already enabled for continuing biological reactions. The team has not only shown that enzyme-based lithography is feasible on protein surfaces, it has further begun to describe the mechanisms that can be used for controlling the nanosized surface features. The team is comprised of Gheber, Rodica Ionescu and Robert Marks. Coverage: [Nanotechweb](#).

▪ ***Knesset Committee to Draft Israel Nanotechnology Law***

The Knesset Committee on Science and Technology held a special hearing on December 22 to explore the state of nanotechnology development in Israel. They heard from the directors of leading research institutions as well as from members of the Israeli National Nanotechnology Initiative.

Among the topics discussed were the current level of funding support for nanotechnology by the Knesset, and a comparison to the support levels provided other developed nations. The 4-year, \$3.7

billion [21st Century Nanotechnology Research and Development Act](#), which became US law in December, was one of the models provided.

As a result of the hearing, the Committee has decided to draft an Israeli Nanotechnology bill that will address the tremendous scientific, industrial, financial and business challenges that are posed by the Israeli nanotech ramp-up. Those interested in contributing to this endeavor are urged to contact [Doron Gurevich](#) who is an assistant to Knesset Member and Committee Chair Meli Polishuk-Bloch.

- ***First Bio-Inspired Engineering Symposium Held at Technion***

The first International Symposium on Bio-Inspired Engineering ([ISBIE](#)) was held December 8-9 at the Technion in Haifa. The symposium brought together diverse audiences from academia, technology and industry to create an interdisciplinary forum for exchange. The event drew several hundred participants, among them researchers from fields such as chemistry, physics, biotech and bioinformatics, pharmacology, computer science, materials science and aeronautical engineering.

Among the 18 speakers appearing at the ISBIE were researchers from Oxford, Harvard, the Scripps Research Institute, Xerox PARC, Bell Laboratories, the Technion, Weizmann Institute, Hebrew University and Ben-Gurion University. Over 40 interdisciplinary posters were also featured.

The conference is part of a series which intends to fire up the interfaces between molecular life sciences and the engineering sciences. Symposium organizer [Ehud Keinan](#), Professor of Chemistry at the Technion, describes two streams of knowledge that are represented by the ISBIE, each evolving in opposite directions. One stream of knowledge flows from the engineering disciplines towards the life sciences; the opposite stream flows from life sciences towards the engineering disciplines. Keinan notes that, especially in recent years, many of the most significant advances in applied technologies have resulted from the interfaces created between these two streams.

The first ISBIE was sponsored in major part by the law firm Mintz Levin, IBM Life Sciences Group, Africa Israel Investments and Teva Pharmaceuticals.

- ***New Hebrew University Nano Unit Offers Training***

Beginning in January, the [Unit for Nanoscopic Characterization \(UNC\)](#) at the Hebrew University will provide training courses for researchers who wish to learn how to use and operate the facilities of the Unit.

The training is intended for graduate students and researchers who plan to routinely use the UNC facilities for their research projects. Courses will provide technical and scientific background for UNC tools, introduction to usage techniques, and practical hands-on sessions.

Following successful participation in the courses, users will be granted permission for independent use of the instrument for which they have received training. The first round of courses will cover use of the Quanta Scanning Electronic Microscope (SEM), the Scanning Probe Microscope (SPM), and the X-Ray Diffractometer (XRD).

For more information, contact [Inna Popov](#), Head of the UNC.

- ***Ha'Aretz Focus Group Plans Day-Long Nanotech Conference***

Focus Ha'Aretz, the conference and events arms of the Israeli newspaper Ha'Aretz, is planning a business conference on nanotechnology in Israel, to be held February 16 at the Hilton in Tel Aviv.

Currently, topics for the day-long conference include surveys on the state of nanotech throughout the world, financing alternatives, intellectual property rights, academic research and industrial activity. There is also talk of adding a session on product development and marketing. For more information, contact Project Manager [Clemi Slonim](#) at Focus Ha'Aretz.

▪ **Nanotech Advantage Israel Seeking Writers**

Nanotech Advantage Israel needs free-lance writers who are interested in the expanding field of nanotechnology and have a background in business and in marketing highly technical products, either in Israel or in the US. Currently, only free-lance writers capable of fulfilling assignments are sought, with compensation provided at market rates. [Join us](#) at Nanotech Advantage Israel, and help to make Israel a world leader in nanotech business development.

## Applying to Europe's FP6

[Return to Contents](#)

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*Continued from [above](#)*

In coming months, there will be four calls for nanotech projects under FP6 amounting to 430 million Euros. The first call deadline is March 2, 2004 and the second call deadline is May 12, 2004.

For a complete list of open nanotech topics under the NMP, see the [NMP Open Calls](#) page.

### **How to Apply?**

Before a company commits to the FP6 proposal process, it's important to know about three key elements that must be addressed:

- **Topic.** FP6 is a top-to-bottom program. This means that a project proposal must address at least one topic in the list of open topics that published periodically by FP6 officials.
- **Consortia.** To be considered eligible for FP6 project funding, your company must work in a consortia. The quality of the consortia is a key consideration, and is evaluated thoroughly.
- **Innovation.** This is the most important element to address in your proposal. During evaluations, the FP6 reviewers apply the highest standards in the industry. It is very important to recognize this when planning and creating the proposal.

When weighing your proposal, using the services of a business development consultant or a professional partnering firm can make the winning difference.

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**Yoram Bar-Zeev** is a partner in the Tel Aviv-based development firm **2Ys Ltd**, providing business development, consulting and public procurement services to companies in Israel and abroad. During the EC's FP4, FP5 and FP6 programs, **2Ys** partners have been involved in fundraising activities for more than 15 Israeli projects, with an overall budget totaling 30 million Euros. For more information, contact [Yoram Bar-Zeev](#).

## Advisors and Resources

[Return to Contents](#)

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Many people have contributed their knowledge, skills, experience and support to this issue of **Nanotech Advantage Israel**. We'd like to take this opportunity to also thank: Shlomo Maital, Tal Lipovetski, Ari Ferziger, Jonathan Ferziger, Einat Zisman, Samuel Pohoryles, Adi Volnitzer, Kobi Simana, Yosi Shacham-Diamand, Ron Maron, Lauren Itzhak, David Miron-Wapner, Reshef Tenne, Ehud Keinan, Yuvi Kahana, Adi Mogilevsky, Dan Vilenski, Meir Weinstein, Einat Wilf, Uri Sagman, David Brinn, James R. Mitchell, Bruce Layman, Bill Rus and Bo Varga.

This issue is dedicated to the memory of Dr. J.R. Phumulela Mitchell. With his sudden passing, our world has lost a truly spirited, multi-disciplined artist and innovator.

To add your knowledge and support to nanotech commercialization efforts in Israel, [contact us](#) and we'll tell you how.

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## About Nanotech Advantage Israel

[Return to Contents](#)

The **Nanotech Advantage Israel** newsletter, founded in 2003, is published to heighten awareness of the special abilities and characteristics of the scientific and business communities in Israel, and help to accelerate the development of nanotechnology as a key industry enabler in Israel. **Nanotech Advantage Israel** is published by Bob Rosenbaum and the Small Advantage consultancy, with invaluable aid from our sponsors, contributors and advisors.

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Bob Rosenbaum is active in product development, marketing and communications for the technical and engineering sectors in Israel and in the United States. His experience in nanotech began in 1988 as a marketing consultant to Cornell University and the very first US National Center of Excellence to be created for nanofabrication. Bob is available to answer your questions about Israeli nanotech and to discuss business collaboration to benefit both Israel and the US.

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