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NANOTECH REPORT

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Nanotechnology's Power Brokers

Tell Me What You Think and Get a Free Issue!

I want to make this a better newsletter for you, my readers. So let me know what you think of the *Forbes/Wolfe Nanotech Report* by filling out the enclosed survey and I will extend your subscription one month free of charge! Just write your address at the end of the survey and send it back to me in the enclosed envelope.

Based on my visits with nanotechnology insiders, research scientists and venture capitalists, I can happily report that despite the overall gloom gripping the country and the stock market, the emerging nanotechnology business is buzzing with activity. In these early stages, business people and techies are jockeying for position. Who are the players in the field wielding the respect and power to bring nanotechnology from the idea to application, from start up to market leadership?

My team at *Forbes/Wolfe Nanotech Report* surveyed leading investors, scientists, corporate execs and high-ranking government officials to give our subscribers a jump on who the top movers and shakers are in nanotech. We took their responses and combined them with quantitative criteria to get our results.

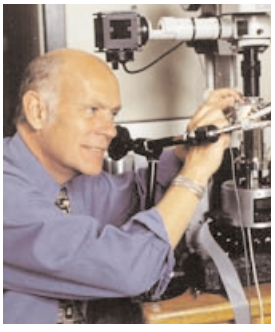
1. Mihail "Mike" Roco

Director, National Nanotechnology Initiative (NNI)

The government's original voice on nanotech, Mike Roco (*see Thinking Small, July 2002*) helped launch the NNI in January 2001 with $422 million from President Clinton. Under Roco's watch, 16 federal agencies now compete for federal nanotech research funding, which has grown from $116 million in 1997 to a projected $849 million in 2004. Roco also serves as Senior Advisor for Nanotechnology at the National Science Foundation (NSF). Some say his broad influence has faded in recent months as the industry grows legs of its own, but Roco still has the ears of Beltway power players, corporations and academic researchers.

Key Achievement: Leading architect of the NNI.

2. Richard Smalley



Co-Founder, Carbon Nanotechnologies, Inc.

The chemist and carbon nanomaterials king was one of the winners of the 1996 Nobel Prize in Chemistry for discovering carbon fullerenes (60 carbon molecules in spherical form known as "buckyballs"), a relative of carbon nanotubes. With $15 million in venture financing, Smalley spun his Rice University research into Carbon Nanotechnologies, Inc. (CNI) to commercialize single-walled nanotube production (*see "Asian Nanotech Fever Running Hot," January 2003*). He also serves on the Scientific Advisory Boards of CSixty (*see "Nanotech Takes on AIDS," February 2002*) and NanoSpectra Biosciences (*see Companies to Watch, September 2002*).

Key Achievement: Key scientific discovery of C60 fueled carbon nanotechnology's emergence as a viable industry.

3. Larry Bock

CEO, Nanosys

A founding investor in 14 companies, eleven of which have been acquired or gone public with market caps over $1 billion, Larry Bock (*see Thinking Small, p.5*) knows how to build a business. His entrepreneurial footprint includes **Caliper** [CALP], **Illumina** [ILMN], **Pharmacopeia** [POCP] *(see "The Microsoft of Molecular Modeling?," October 2002*), **Vertex Pharmaceuticals** [VETX], and **Neurocrine** [NBIX]. Bock is now placing his chips on nanotech as the CEO of Palo Alto, California's Nanosys (*see "A Recipe for Success," September 2002*). Nanosys has used its $17 million VC war chest to license more than 70 nanotech patents and patent applications from leading researchers, including Nanotech Power Broker list members Charles Lieber, Paul Alivisatos, and James Heath. Could Nanosys be Bock's next billion dollar baby? The challenge will be successfully transitioning his IP goldmine into products, but Bock is up to the task.

Key Achievement: Being first mover to round up IP platform for nanotech startup.

INSIDE

4. Charles Lieber

Chair of Chemistry, Harvard University

Charles Lieber (*see Thinking Small, March 2002*) was the first nano guru we profiled in our inaugural issue last year and with good reason. He holds the Mark Hyman Chair of Chemistry at Harvard University and is a Fellow of the American Physical Society and the American Association for the Advancement of Science. I predict Lieber will contend for a future Nobel Prize in Chemistry. He has already been recognized with a number of awards, including the Foresight Institute's 2001 Feynman Prize, one of the nanotechnology community's top honors. He is a co-founder of Nanosys, which was formed to commercialize his work in nanowires, nanodots and nanotubes, for end use in sensors and nanoscale electronics.

Key Achievement: Leading expert in semiconductor nanowire devices and "bottom-up" assembly.

5. Mark Modzelewski

Executive Director, NanoBusiness Alliance

Mark Modzelewski co-founded the NanoBusiness Alliance with me in the fall of 2001. He now serves as the organization's Executive Director. His power (*see Thinking Small, December 2002*) lies in his status as the central hub of the nanotech industry: the go -between among scientists, venture capitalists, government officials and executives.

Mark's tireless efforts on three fronts: disseminating nanotech information; reducing business hurdles for nanotech companies; and influencing governmental policy through lobbying, make him one of the most important power brokers. No one understands the worlds of government, public policy and their marriage with science better. If someone's got an agenda, they've got to pass through his non-profit industry clearinghouse before it will be seen by government officials and industry leaders.

Key Achievement: Increasing awareness and importance of nanotechnology across the nation for policy makers and general public.

6. Chad Mirkin

Professor of Chemistry, Northwestern University

This young, dynamic Northwestern researcher is just as likely to be seen in *Esquire* (in a November photo spread selecting him as one of the 40 "Best and Brightest") as in the pages of *Nature* or *Science*. Chad Mirkin is the George B. Rathmann professor of Chemistry and Director of the Institute of Nanotechnology & Center for Nanofabrication and Molecular Self-Assembly. A regular in the *Follow the Money* section of this newsletter, Mirkin has already launched two startups (Nanosphere and NanoInk) and raised more than $32 million. His research landed him Foresight's 2002 Feynman Prize.

Key Achievement: Simultaneously launching two funded nanotech startups while continuing his research.

7. Stan Williams

Director of Quantum Science Research, Hewlett-Packard

With corporate might and scientific research capabilities at his fingertips, **Hewlett-Packard's** [HPQ] Stan Williams (*see Thinking Small, June 2002*) is outspoken about the naiveté of start-ups that think they can threaten HP's leadership in molecular electronics. Williams is a Senior HP Fellow and director of Quantum Science Research. HP's role in nanotech R&D can't be underestimated. Williams currently leads HP Labs' nanostructures and quantum effects research, with the intention of providing a foundation for the device technology of the next century. He has remained uncharacteristically quiet over the past several months after his much publicized cautionary comments on nano-hype in the *Wall Street Journal*. The 2000 Feynman Prize co-winner is now putting HP's research dollars to work with the intention of making the hype a reality.

Key Achievement: Leading molecular electronics researcher who adds tempered voice of nanotech enthusiasm.

8. Phaedon Avouris

Manager of Nanometer Scale Science and Technology, IBM

Phaedon Avouris heads the nanotech team at the most influential corporate player involved in nanoscale research. At **IBM's** [IBM] T.J. Watson Research Center, his current research is focused on molecular electronics and carbon nanotubes. His team is part of the reason IBM tops the charts in patents year after year. Avouris is a fellow of the American Physical Society, American Association for the Advancement of Science, New York Academy of Sciences and a winner of the Foresight's 1999 Feynman Prize. IBM's vast resources allow Avouris the ability to partner with or crush startups nearly at will. He has strong opinions on roadmap and future direction of technologies like carbon nanotubes. If he's right, IBM will win big. If Avouris is wrong, he'll have a difficult time back peddling.

Key Achievement: Directing breakthrough nanoscale research for the biggest company in nanotechnology.

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Nano in the News

Nanofiber bandages heal wounds, absorb into the body

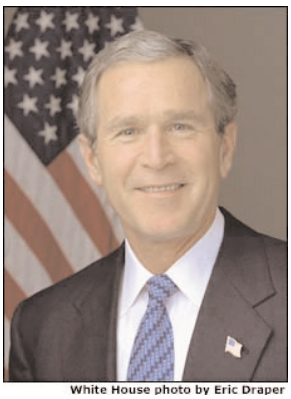
Researchers at Virginia Commonwealth University recently developed a gauze pad spun out of the same natural fiber in your body which clots blood. Instead of ripping off a normal bandage and damaging skin and disrupting the blood clotting process, the nanobandage acts as a scaffold into which tissue-forming cells can grow and move. The body would treat it simply as part of normal healing, gradually dissolving it as new skin grows over the wound

9. George Pataki
Governor, New York State

New York Governor George Pataki has been the driving force behind a nanotechnology spending spree in the state: a $400 million International SEMATECH North center for nanoscale semiconductor research, a $50 million investment in Albany Nanotech and attracting a $300 million **Tokyo Electron** [TOELF.PK] research facility to Albany. With Pataki's blessings and many of his senior staff championing nanotech, New York State could become the Silicon Valley of nanotech.

Key Achievement: Making New York State into U.S. nanotech's biggest governmental backer aside from the federal government.

10. George W. Bush
President, United States of America



White House photo by Eric Draper

When former President Bill Clinton, the NNI's original backer, vacated his office, the nascent initiative's fate was in limbo. But despite economic uncertainty and a budget crunch, President George W. Bush has followed through and boosted the federal government's investment in nanotech. At stake? Nothing less than global economic and technology competitiveness. Japan will spend nearly $1 billion on nanotech research in 2003, while the U.S. is slated to spend $710 million. When the smoke settles in Iraq, look for Bush to start promoting the government's nanotech priority, similar to his State of the Union support for AIDS research, as the international race intensifies.

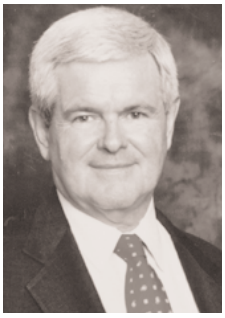
Key Achievement: Continuing the federal government's commitment to nanoscale science funding to maintain U.S. competitiveness.

Honorable Mentions

K. Eric Drexler
Founder, Foresight Institute

Eric Drexler is the founder and Chairman of the Foresight Institute, a Palo Alto, California-based non-profit educational group focused on preparing society for advanced nanotechnologies. He credits himself with introducing the term "nanotechnology" in the mid-1980s and was the author of the futurist book "Engines of Creation" that caught the science community's imagination. A lightning rod of controversy, Drexler's critics say his futuristic visions of nanotech are science fiction and litter the popular media, detracting from nanotechnology's more practical scientific progress.

Newt Gingrich
Former Speaker, U.S. House of Representatives



At a recent event for a new Albany nanotech facility, my fellow panelist Hillary Clinton joked that the only thing Newt Gingrich, George Bush and her husband agree on was the importance of nanotech. Since leaving the House in 1998, Newt has reappeared as one of nanotech's biggest backers on the Hill by serving as the NanoBusiness Alliance's Honorary Co-Chairman (with Steve Jurvetson) and giving speeches on the importance of nanotech.

James Heath
Professor of Chemistry, Caltech

Young and aggressive, Heath just moved to Caltech in January from UCLA, where he established a reputation as one of the world's leading molecular electronics researchers. His demonstration of an electronically configurable molecular-based logic circuitry (along with HP's Stan Williams) represented a significant step toward the goal of creating cheaper, smaller and more energy-efficient molecular computers (*see "2002 Year in Review: Top 5 Nanotech Breakthroughs", December 2002*). He is also a founding member of the Nanosys Scientific Advisory Board and 2000 Feynman Prize co-winner. Heath gained political power by playing a large role in establishing and serving as interim director of the California NanoSystems Institute (CNSI), a 180,000-sq/ft state of the art nanotech research facility shared by UCLA and UC Santa Barbara.

Steve Jurvetson
Partner, Draper Fisher Jurvetson

Steve Jurvetson first rose to venture capital prominence when his investment in Hotmail was acquired by **Microsoft** [MSFT] for more than $400 million. Today the Silicon Valley-based VC has become one of nanotech's leading advocates and investors. Many companies I have featured in this newsletter like Imago Scientific, Konarka Technologies, Molecular Imprints, NanoOpto, Nantero and ZettaCore have received funding from his firm.

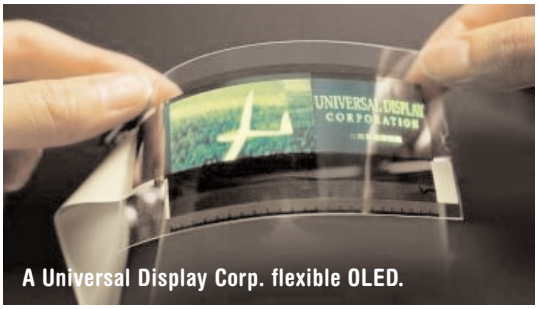
Sam Stupp
Professor of Chemistry, Northwestern University

Quiet and hard working, Sam Stupp has been called the guru of the organic world, widely regarded as one of the top experts in regenerative medicine. Stupp uses nanoscale science to focus on the regeneration of bone, heart and nerve tissue. He has assembled a cadre of powerful Nobel Prize winners and ex-White House officials behind his new nanobiotechnology startup. He is a Board of Trustees professor of Chemistry, Medicine and Materials Science at Northwestern, and a director of its Institute for Bioengineering and Nanoscience in Advanced Medicine. As chairman of the NNI Review Committee, Sam has been a critical behind-the-scenes driver of the government's nanotech strategy.

Nanodisplays: DuPont takes on Kodak

The Kodak moment of this century will occur when people turn on their screen." Those are very bold words, but Leslie Polgar, president of **Kodak** [EK] Display Products, is extremely confident about OLEDs. "We are the inventor of this entire field of this technology. Period."

Don't confuse OLEDs with LEDs. I explained last month that LEDs are inorganic and ultimately might replace light bulbs. OLEDs (organic light emitting diodes) are organic and will be used to create full color screens to replace LCDs (liquid crystal displays). While LCDs require backlighting, OLEDs emit their own light. This means that they are much brighter than LCDs, where only 5% of backlight comes through. It also means they have a wider viewing angle, nearly 165-degrees. LCDs need to be viewed head on. The end user sees a higher contrast, brighter, more beautiful display with a refresh rate 1,000 times better than LCDs. In short, it's faster, brighter, wider and sharper.



A Universal Display Corp. flexible OLED.

The stakes are high. In the next five years, research firms expect the OLED market to be worth $2.3 billion. OLEDs come in two flavors: small molecules and polymers. Kodak claims the largest patent portfolio in the field for small molecules. It partnered with **Sanyo** [SANYY] in 1999. Together, they demonstrated a working portable DVD display and a 14.7" HDTV display the thickness of a quarter. Next year you will see full color OLED displays measuring between 1.5" and 2.5" in digital cameras and cell phones. The following year will deliver the first 12" full-color active-matrix laptop display.

Kodak originally planned to license their patent portfolio for passive matrix displays and to develop and sell the chemicals that made the them. By 2000, Kodak counted Pioneer, **TDK** [TDK] and four others as licensees. But after unveiling a 5.5" OLED display made with Sanyo at a conference in late 2000, top management decided to form a full business unit that would also make and market full color active matrix displays. In September 2000, the company helped Pioneer provide **Motorola's** [MOT] Timeport cell phone with an OLED screen that commanded a $100/unit premium over competing LCDs. The next plan is to forward integrate into Kodak branded consumer products. In fact, Kodak just launched the Easyshare LS633 digital camera with a 2.2" OLED screen. It retails for $399. While **Intel** [INTC] tried this and failed, Kodak is already in the camera business.

Kodak, which was the best performing stock in the Dow last year, has the support of some powerful institutional investors. Legg Mason's star fund manager Bill Miller recently told *Barron's* that he thought Kodak was worth roughly $50 a share. It currently trades for around $29. He specifically highlighted the OLED sector, forecasted to be a $500 million business within five years.

One problem. Kodak's small molecules OLEDs are hard to dissolve in liquid. This means that manufacturing them is more difficult and expensive than the alternative polymer-based mathod. My sources tell me an active matrix manufacturing plant costs between $500 million and $1 billion to build. Because of this, **DuPont** [DD] is focusing on the polymer-based method. DuPont Displays has only been in the game for three years, but thanks to a flurry of licensing deals and acquisitions, it's a major contender. Its polymer-based OLEDs can be manufactured in solution and sprayed onto a screen just like ink-jet printers. This theoretically comes at a much lower production cost.

DuPont most recently teamed up with Ewing, New Jersey-based **Universal Display Corporation** [PANL] in December 2002 to push its OLED technology closer to commercialization. UDC already has a joint development agreement with Sony to make OLED TVs. They also have over 150 OLED patents.

Right now DuPont is trying to ramp up its manufacturing capacity. Steve Gallo, vice president for OLEDs, says it's going after applications that might sell 500,000 units per year to dip their toes in the water. Popular cell phones might do double or triple that volume. DuPont will soon begin shipping single color 128x64 passive matrix displays for portable devices like MP3 players. The crisper and brighter color displays fetch about a $10 premium on a $200 product.

Gallo expects that prices five years from now will be 2-3x less than what they are today and the displays will command between a 25%-100% premium from the electronics manufacturers over LCDs.

Another company worth watching is Cambridge Display Technologies (CDT), in which DuPont has invested an undisclosed amount. CDT was started by Cambridge University professor Richard Friend to focus on developing a patent portfolio and the basic materials. But CDT decided it didn't want to be material suppliers and handed it over to polymer suppliers like **Dow** [DOW]—which now sells some of the polymers. But it has continued to acquire IP: CDT has over 100 licensees and has raised over $160 million in funding, a majority coming from Kelso Investment Associates and Hillman Capital of New York in 2000. DuPont, Sumitomo Chemical, and Toppan Printing Co. Ltd. of Japan, have also placed equity investments. Stewart Hough, CDT's VP of business development, tells me that CDT expects to be floated as a public entity within 24 months. Expect this to happen on the LSE, but there is an outside chance it could be on the Nasdaq.

My prediction? OLEDs won't completely replace LCDs, but instead will win market share by targeting small niches one by one as consumers see better performance for the price. The entire industry is expecting first sales of OLEDs to be transacted this year. Kodak, with the help of its development partners, will see near term revenues quicker than its competitors. DuPont may acquire CDT to get its IP before it can go public. Meanwhile, DuPont will leverage its processing know how and be able to make OLEDs via solution processes more cheaply. If this happens, Kodak shareholders betting on big returns from its new OLED business might be disappointed. ¤

Nano in the News

Applied Nanotech demonstrates carbon nanotube TV

SI Diamond Technology [SIDT.OB] (*see Companies to Watch, August 2002*) subsidiary Applied Nanotech demonstrated a 14" diagonal monochrome TV based on electron emission from carbon nanotubes. Samsung had been the only company to show a nanotube TV. As I reported in April, Samsung expects HDTVs by Christmas 2003.

Thinking Small: Larry Bock

The most important part of any business is the people running it. In September (see "Nanosys: A Recipe for Success," September 2002) I revealed nanotech startup Nanosys' secret recipe for success drummed up by Larry Bock, a guy who's made his fortune by launching over 11 biotech companies each sporting market caps exceeding $1 billion. Warren Buffett's partner, Charlie Munger, once advised using mental models to recognize patterns. This applies to nanotech too. This month, Bock and Stephen Empedocles (Nanosys' director of business development), have provided me with an exclusive excerpt from a confidential white paper they have produced on nanotech and its future. They think that nanotech investors can learn greatly from studying the evolution of the biotechnology industry.

Twenty years ago, the biotechnology revolution changed the way we live and redefined the way that business was done in the pharmaceutical industry and in the venture capital community. Today, nanotech is a new revolution. It will impact a far greater number of industries than biotech ever did.

In the early 1980s, the discovery, characterization and manufacturing of new therapeutic proteins was a long and expensive process. For example, the production of insulin required the slaughter of thousands of pigs, the painstaking removal and grinding up of their pancreatic organs and the cumbersome isolation of the insulin protein. Only the largest pharmaceutical companies were able to compete.

But with the advent of recombinant DNA technology and a simple lab, a clever student could clone and express virtually any naturally occurring protein. He could even produce heretofore unimagined proteins. Success became driven by the creativity of the individual scientist, not the scale of operations. This was a situation ripe for venture capital. A new biotech industry emerged and major pharmaceutical companies partnered with smaller genetic engineering firms that offered the brightest new scientists.

We think that nanotech will have the same impact in microelectronics, macroelectronics, optoelectronics, data storage, and virtually every other commercial industry. Consider semiconductors. Current microfabrication facilities cost over $100 million, preventing small companies from competing with giants like **Intel** [INTC].

But by using nanotechnology, a single chemistry graduate student can create novel devices and device architectures not even imaginable or manufacturable by today's biggest microprocessor companies. That's because these devices are fabricated chemically, or from the "bottom up." Existing microelectronics technology is fabricated by etching wafers, or from the "top down."

Specifically, growing complex structures into single nanostructures through a chemical synthesis is one of the truly unique and powerful characteristics of nanotechnology. This is happening at a level 10,000 times smaller than a transistor on an Intel Pentium 4 chip. For example, take LEDs made of different semiconductors. Even the most expensive equipment in modern fabrication facilities can't get certain materials integrated into a single device at the macroscale. But at the nanoscale, the creativity and know-how of the scientist is more important than the size of a research facility.

Thinking back to the early days of biotech, recombinant DNA allowed researchers to not only define the structure and function of a protein, but also explore functional properties of a protein. This let them do massive screening of drug candidates and created a dramatic increase in the rate of discovery. It also allowed researchers to discover properties they weren't aware would be interesting until they had discovered them combinatorially.

Nanotechnology allows the same power of combinatorial fabrication to be extended to the realms of electronics, optics and optoelectronics. The ability to synthesize new materials and literally define where each and every atom is located is analogous to the advent of biotechnology.

Since the biotech industry was so utterly new, it had to invent many of its own unique business models. So will nanotech. The technology is disruptive, the skill and mind-set required to commercialize the technology will be radically different from what exists in industry today, and key intellectual property will be developed in academia instead of industry. Why? Because the National Nanotechnology Initiative (NNI) is projected to become one of the government's largest scientific initiatives since the Human Genome Project that propelled the biotechnology industry. It will be difficult for major companies to remobilize and dominate this new field. Simply put, the major industrial players will have to partner with small companies to gain access to this new technology.

Right now, there is no experienced talent pool to commercialize nanotechnology. All of the domain experts are academics and even at the major corporations active in nanotechnology research like **IBM** [IBM] and **Lucent** [LU], their primary driver is scientific publications. There are, for the most part, no university programs on commercializing nanotechnology.

And like biotechnology, nanotech is multi-disciplinary and will require the workforce to be made up of natural communicators across multiple technical fields like material science, optical and electrical engineering and even biotechnology. Therefore, the nanotech workforce of the future will be drawn from a combination of talented young scientists from university labs and experienced new-technology "commercializers" without specific nanotech experience. These commercializers will have experience at multi-disciplinary companies such as **Caliper Technologies** [CALP], **Symyx** [SMMX], **Affymetrix** [AFFX], and **Applera** [ABI]. As was the case in biotechnology, small venture backed companies located next to major universities will be the best equipped at attracting and retaining this type of talent pool.

Finally, the role of intellectual property and technology licensing will be as important in nanotech as it was in the life sciences. This is because the technology is so disruptive that it is possible to patent everything from the key concepts to the fundamental compositions of matter to the processes and methods of producing the device to the end applications and systems. We expect the most exciting companies in the field to come from the key universities like Harvard, MIT, Stanford, Princeton and the government sponsored NNI, making technology licensing a key strategy for success. ¤

Companies to Watch

JPK Instruments

[Private]

www.jpk.com **49 (0) 30 5331 12541**

Berlin, Germany

Chief Executive: Frank Pelzer

What it does: Makes AFMs for the life sciences market.

Still think nanotechnology profits are years away? JPK Instruments will change your mind. This Berlin, Germany-based startup, launched in 1999, introduced its first product in June 2002. Six months later, it has already turned a profit. How'd it do it? By being one of the first to optimize Atomic Force Microscopes for the life sciences market by integrating traditional optical microscopy tools.

Started by two physicists and an MBA student from Humboldt-Universität in Germany, JPK was formed to seize the opportunity in the blossoming nanotechnology tools market. "We saw **Veeco** [VECO] as a big player in the instrumentation sector," says CEO Frank Pelzer. "But they were in the semiconductor and materials science market. Hardly anyone was in life sciences." At the time Digital Instruments, now owned by Veeco, had a "BioScope" which was starting to look at soft metals. "The customers only had one supplier in the space, DI, so they had to play by their rules. The customers wanted competition, they wanted more innovation which would come about with market pressure."

With nanotechnology research on the rise worldwide and researchers hungry to explore the biological realm at the nanoscale, JPK raised several million dollars in 2000 from Berlin venture capital firms IBB Beteiligungsgesellschaft mbH, TBG (the VC division of the business development arm of the German government) and Innovations fonds des Landes Berlin. The company also secured a grant from the German Ministry of Economics.

In May 2000, JPK began building what would become its first product, the NanoWizard AFM. The NanoWizard combines an ordinary optical microscope (for determining what mechanical, chemical, and optical properties a sample has) with an AFM (for imaging and manipulation). As we found in our August 2002 Tools Survey (*see "Nanotech Tool Time," August 2002*), this functionality is exactly what people are asking for.

"We will be #1 in cell research," says Pelzer. "All pharmacologists want to know how drugs influence cells. We can see how viruses go into the cell. We can measure how fast this happens and if the drugs can make it happen faster. We're not fishing in the dark anymore."

Eighty-five percent of JPK's current customers are German research institutes, but with U.K. and French distribution contracts already in the works, expect to see the $130,000 NanoWizard Systems spreading like wildfire throughout the European research community. When will you see NanoWizards in the U.S? Pelzer says JPK will enter the North American market in 2005 after establishing a solid base in Europe and Asia. Together, they comprise 45% of the potential scanning probe microscope market. In the interim, JPK is keeping a very close eye on U.S. competitor Asylum Research (*see "Sub Atomic Super-Scopes," April 2002*). While this is a concern, I predict Asylum will spend its time navigating a Veeco-made Bermuda-triangle of patent infringement, while JPK steams ahead closer to an acquisition by a major tool provider.

Nanoplex Technologies, Inc.

[Private]

www.nanoplextech.com **(650) 230-1589**

Mountain View, California

Chief Executive: Michael Natan

What it does: Develops nanoparticle bar codes.

You're the CEO of a luxury retail brand. You walk out of your board meeting stunned to have just learned that your top line is getting sacked by a surge in counterfeit activity and unauthorized supply chains. Retailers saw inventory shrinkage cost them $31 billion last year. What sounds like a nightmare to many in this situation is music to Michael Natan's ears. As CEO of Nanoplex Technologies, Natan is making a hard push to get his company's nanobarcode particles into widespread use to track supply chains and identify gray market activity.

Natan had wanted to make wires with notches that could assemble in 3 dimensions like the popular children's toy Lincoln Logs, but couldn't. So he made chemical grooves instead of notches. When he saw the alternating patterns he realized they looked like nanoscale barcodes.

In 1999, Natan became CTO of SurroMed—which had been founded to develop biomarkers to do life science experiments—but his technology didn't get put to work right away. It needed more money for development and didn't get the proper attention because its largest market opportunity was in something other than life sciences.

The technology was licensed to SurroMed in 2000 and then spun out in 2002. Nanoplex quickly won a three-year $4.5 million Advanced Technology Program grant to create nanobarcodes to tag biomolecules. SurroMed has not infused any capital, but has offered to provide real estate and administrative services for future equity.

The nanobarcodes are alternating strips of gold and silver in a cylinder shape measuring as thin as 100 nanometers. Since gold and silver reflect light differently, a reader can distinguish between a series of alternating patterns of the two. When the software reads the data coming in from the reader, it distinguishes between gold and silver, making a binary code that can an incredible amount of information.

The barcodes are just one piece. You need an optical reader and the company's software. It will eventually sell a handheld reader for roughly $100. Nanoplex is talking with **Olympus** [OLYOY.PK], a major optical microscope maker that would love to see nanobarcodes become a consumable product with a **Gillette** [G] razor blade business model.

The *New York Times* recently ran an article highlighting a competing technology, RFID (radio-frequency ID tags). Each tag costs $0.30, and the goal is to be able to sell them for $0.05. But even at a nickel each, if a billion units are required, that's $50 million. Comparatively, Nanoplex is much cheaper. Natan estimates it will cost approximately $10,000 to make a billion unique codes. But there are other advantages. He estimates 10% of the $7 billion luxury watch business is lost to counterfeits. RFID's won't work with metals because the signals get interference, but the nanobarcodes would have no problem.

Sounds great, but there are some problems. There's a lot of technology risk to get sorted out. And retailers don't want technologies; they want answers to their problems. The company will need to raise about $3 million giving away 50% of the company to a strategic investor to get things into high gear. ¤

Follow the Money

A monthly look at who in nanospace is getting funding and who's giving it.

Venture Investment

Nanogram Devices

www.nanogramdevices.com

Location: Freemont, California

Lead Scientist/CEO: Dania Ghantous/Ken Westrick

Funding Announced: 2/3/03

Investors: **Harris and Harris Group** [TINY], Venrock Associates, Nth Power Technologies, Bay Partners, Rockport Capital Partners and SBV Ventures Partners

Funding Amount: $9.2 million

Notes: We first profiled NanoGram Devices as a spin-off of privately held NeoPhotonics Corporation (*see Follow the Money, April 2002*). Armed with $25 million in venture funding, NanoGram Devices is commercializing power sources for medical devices such as cardiac defibrillators and pacemakers based on its Nano-Silver Vanadium Oxide (SVO) technology. This provides batteries with 50% more capacity and at an 80% higher rate than traditional SVOs.

Outlook: President Jason Lemkin says their power source technology has been in development for three years and that Nanogram Devices is working with an undisclosed medical device company. With **Medtronic** [MDT] owning 50% of the high and low-powered cardiac device market and **Guidant** [GDT] in second, I'd be surprised if that undisclosed partner isn't one of the two. A recent Merrill Lynch report on medical technology said the high-powered cardiac device market should grow at 20% over the next few years.

Solubest Ltd

www.solubest.com

Location: Rehovot, Israel

Lead Scientist/CEO: Rina Goldshtein/Erwin Stein

Funding Announced: 2/9/03

Investors: Alplex BV (Netherlands)

Funding Amount: $1.4 million

Notes: Chemical and biopharmaceutical company using nanoparticles to improve the solubility of 3 types of drugs: anti-fungal, anti-cancer, and antibiotics. Antifungal (focusing on AIDS) and antibiotics (focusing on azithromycin and clarithromycin) are furthest along with animal trials. Claims to have doubled the bioavailability of its antibiotics in animals. Have contract research projects and revenues from two undisclosed U.S. and one Israeli pharmaceutical company. Plans to raise between $3-5 million in venture capital in the next year.

Outlook: CEO Stein has shrewdly directed Israeli government money to Solubest, securing $750,000 from the Ministry of Industry and Trade and $2 million out of a $30 million pool at the state-sponsored Israeli Nanoparticle Consortium. Competing in this arena will be tough: Nanosphere companies **Flamel** [FLML] and **Skyepharma** [SKYE] both use nanoparticle technology to increase the solubility of the drugs. Of the $47 billion of drug patents expiring over the next 10 years, 60% will be reformulated into improved versions. Realizing that time is not on their side, many of the pharmaceutical companies are approaching start-ups like Solubest much earlier than normal. Solubest already has contracts with two undisclosed U.S. drug companies and one contract with an Israel-based drug company.

Government and State Grants

Manchester University

Funding: British Office of Science and Technology

Funding Announced: 2/3/03

Funding Amount: £34 million ($53.6 million)

Notes: The Manchester Centre for Mesoscience & Nanotechnology opens on April 7 and is designed for multidisciplinary research in materials, tissue engineering, and optoelectronics. Part of this money will be used for nanotechnology research and equipment. Already Manchester has allocated about £5 million, £1.5 million of which went to a new FEI Tecnai Transmission Electron Microscope (*see "Jilted FEI Poised for Rebound," February 2003*).

University of Alberta (Edmonton, Canada)

Funding: Government of Alberta & **Sun Microsystems** [SUNW]

Funding Announced: 2/3/03

Funding Amount: $3.65 million

Notes: The money is going toward the establishment of a Centre of Excellence in Integrated Nanotools (CEINT). Sun Microsystems is donating $2.45 million in hardware, software, storage systems and services. It's betting early that nanotechnology will increasingly rely on high-end computing and software. The centre will primarily focus as software and hardware to design, model, and develop nanotechnology. Alberta has $81 million in government support to develop a Nanocenter by 2005.

M&A

Quantum Solar Energy (Linz, Austria)

Acquirer: Konarka Technologies (Lowell, Massachusetts)

Bankers: Not disclosed

Notes: Konarka (*see Follow the Money, Nov. 2002*) develops flexible, polymer and titanium dioxide nanoparticle photovoltaic (PV) technology. It acquired Quantum Solar Energy (QSEL) from Linz AG, a regional utility company in Austria. It is a leader in organic solar cell technology and has the world's highest reported solar conversion efficiency for an organic cell. Possible applications include solar water pumps, satellite power systems, and electricity grid systems.

Outlook: Konarka's thin film PV technology converts both sunlight and indoor light into direct current (DC) electrical energy. With backers **Chevron Texaco** [CVX] and **Eastman Chemical** [EMN] and growing U.S. government subsidies for alternative energy, Konarka seems well positioned to gain market share. ¤

The Nanosphere

Company [symbol]	Technology	Coverage Initiated	Current Price	52 Week Range	Market Cap ($mil)
Intellectual Property Incumbents *Leading researchers in nanotech, with big potential for spin-offs and revolutionary breakthroughs.*					
IBM [IBM]	Nanoscale storage and nanotube transistors	3/02	$76.70	$54.01–$108.85	$129,600.00
Hewlett-Packard [HPQ]	Molecular transistors and switches	3/02	15.54	10.75–21.35	47,434.00
Instrumentation *Tools that allow researchers to view and manipulate nanoscale matter.*					
Veeco [VECO]	Atomic Force Microscopes	3/02	14.79	9.14-38.80	431.00
FEI [FEIC]	Focused Ion and Electron Beam Microscopes	1/03	15.19	12.35-36.00	495.10
Materials *Companies producing nanoscale materials with novel properties that have applications across a wide range of industries.*					
Symyx [SMMX]	Novel materials discovery	3/02	13.51	7.50–24.79	417.00
Modeling *Companies developing software to visualize, model and simulate matter and activity at the nanoscale.*					
Accelrys/Pharmacopeia [PCOP]	Molecular rendering and analysis software	3/02	6.51	5.99–15.45	152.90
Platform Technologies *Companies that have corralled key intellectual property that will be the foundation of future developments.*					
Nanosys [private]	Nanowires and nanostructure-enabled devices	3/02	n/a	n/a	n/a
Investment Firms *Companies that are investing in promising early-stage nanotechnology startups.*					
Harris & Harris Group [TINY]	Non-volatile RAM, drug delivery, nano-optics	5/02	3.06	1.80–5.50	35.20
Nanobiotechnology *Companies that are working at the intersection of nano- and bio-technology.*					
SkyePharma [SKYE]	Nanoparticle solubilization for drug delivery	8/02	7.15	6.00-11.99	428.50
Flamel Technologies [FLML]	Nano-encapsulation for drug delivery	8/02	4.65	1.10-5.40	75.30

Word on the Street

IBM: IBM shares were left unchanged even as **Dell** [DELL] terminated its $16 billion purchasing contract and cut back on a $6 billion services partnership. Dell said the relationship ended partly because several IBM businesses Dell was working with (including hard disk drives) had been sold. IBM also completed its $2.1-billion acquisition of Rational Software and closed a $2 billion services deal with auto parts maker **Visteon** [VC].

HPQ: Despite meeting earnings forecasts, HPQ was given a 15% haircut on the next trading day following sales figures coming in nearly $600 million lighter than anticipated. While cost cutting since the Compaq merger has largely been successful, the company's inability to grow the top line concerns investors. CEO Carly Fiorina said weakness was confined to the U.S. market, but issued a cautious outlook going forward.

VECO: Veeco appointed metrology head Don Kania president of the company. The post was vacated by current Chairman and CEO Ed Braun. Kania had overseen the successful move into the AFM business and early domination of the nanotech tools market. Wall Street pushed up VECO close to 8% during the month.

FEIC: FEI opened a new 92,000 sq/ft Czech Republic manufacturing facility for production of electron microscopes and Dual Beam systems. This comes at a time when other equipment companies are retrenching and selling off assets. FEI remains one of the best ways to buy into the nanotech tool build-out.

SMMX: Symyx bucked the downward trend in the equity market, advancing 11% on the month. SMMX shares have marched steadily higher since their July 2002 low of $7.50 as the company continues to execute on its business model.

PCOP: Investors saw the disconnect between PCOP's price and its intrinsic value and sent shares 6% higher. The parent of nano-modeling leader Accelrys represents the best nanotech value right now. It trades for 1.08x cash, has no debt and little cash burn. We advise long-term investors to buy more at these levels.

TINY: Investors who took profits in Harris & Harris Group shares, as we recommended in February's *Word on the Street*, were spared a 15% decline. TINY portfolio company NeoPhotonics (*see Companies to Watch, March 2002*) announced it was acquiring troubled Lightwave Microsystems to consolidate its position in optical components. I believe TINY will continue to trade above its Net Asset Value of $2.37 due to retail invetsors demand for nanotechnology, but its current 29% premium seems a bit rich.

SKYE: While SKYE now has 12 products in clinical development, its single blockbuster product is antidepressant drug Paxil CR (with **GlaxoSmithkline** [GSK]). Glaxo's Paxil just suffered a major setback in a Chicago court, losing a patent dispute with Canadian generic drug manufacturer Apoxtex. This ruling could result in a sales slowdown for Paxil: bad news for SKYE.

FLML: Last month, we advised investors to book profits from Flamel's 200% gain since its August addition to the Nanosphere portfolio (*see "Nanobiotech Stocks Added to the Nanosphere," August 2002*). This was right on the money: the stock sold off before recovering to close at $4.65 on March 4. We still think FLML needs to digest some of its recent gains, but its continued strength in heavy trading makes me quite bullish that its recent strength is not just a irrational run-up.

*Stock prices as of March 4, 2003