

Nanotech Takes Aim at the Memory Market

by JoAnne Feeny, Ph.D.



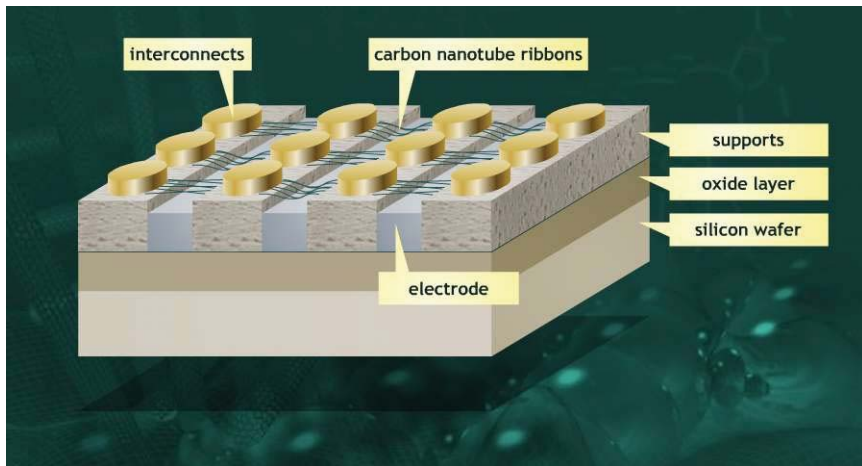
The explosion in

portable consumer electronics is creating new opportunities for designers of more powerful and power-efficient

memory chips. DRAM, SRAM, and Flash have unique advantages, but no one type of memory available today combines the best features of those into a single package. DRAM is cheap, SRAM is fast, and Flash is non-volatile—the sort of memory which requires no power to retain its data. As a result, portable devices will typically use several types of memory, some stand-alone components and others embedded within the device’s processor chip. Ideally, a “universal” memory chip would be able to perform all required functions in a compact package, draw little power, switch in nanoseconds, and cost almost nothing per bit of stored data.

Nantero, a start-up from the Route 128 tech corridor of Boston, is using nanotechnology in an attempt to create such a universal memory. Nantero has invented NRAM,[™] a new form of non-volatile memory. Like Flash, no power is required to maintain the integrity of the data held in memory and Nantero’s NRAM combines the speed of SRAM with the small cell size of DRAM. If Nantero is successful, chip manufacturers may have a solution for on-board memory that keeps power consumption well below today’s levels, takes up little space, and reads and writes as rapidly as today’s leading embedded solution, SRAM.

Nantero is using its specially formulated fabric of carbon nanotubes (CNTs) as the foundation for its revolutionary device architecture. Nantero’s CNT storage devices



Nantero’s nanotubes flex and straighten to form 1’s and 0’s. Source: Nantero.

are built on a substrate of silicon just like conventional integrated circuits (ICs) (see illustration above). Bunches of CNTs are suspended across a gap and an applied voltage causes the CNTs to flex toward a

metal electrode at the bottom of the gap. This turns the storage device or “switch” to the “on” state. The CNTs stay in this bent position until another voltage is applied to
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Nanotechnology Could Revive Investor Interest in Diagnostics

by Juan Sanchez, M.D.



Investing in small-cap diagnostics companies has historically generated disappointing results. For this reason, investors have been

cautious when facing investment opportunities in a sector generally characterized by companies with low valuation multiples. While the current business model may justify such multiples, we believe that nanotech-based innovations could alter the economics of the medical diagnostic business and deliver greater value to investors.

LOW MARGIN BUSINESS

Traditionally, diagnostic companies have operated in an environment which generally is characterized by low gross and operating margins. Diagnostic companies often surrender most of the economics of their products to a corporate collaborator or a large distributor. With little control over distribution channels and poor contact with customers, diagnostics companies are trapped in an environment with low return on investment (ROI). It is no surprise that investor interest has been less than enthusiastic.

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Nanotech Takes Aim at the Memory Market

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turn the switch back to the “off” position. Weak molecular bonds, called Van der Waals forces, hold the CNTs in place and no power is required to refresh the device – this differentiates NRAM from SRAM, where power must be regularly applied to maintain the state of the transistors.

NRAM’s advantages stem from the unique properties of carbon nanotubes. The device architecture exploits not only CNTs’ appealing conductive properties, but also their tensile strength. Nantero anticipates that its devices can switch more than 10^{15} times without failing and this would give NRAM a lifetime comparable to SRAM or DRAM and much longer than Flash. And while SRAM is sensitive to alpha particles, and requires extra circuitry to detect and correct resulting errors, NRAM is unaffected by radiation. For this reason, and because each bit requires only one transistor, NRAM is much smaller than SRAM, which uses six transistors per cell. Also, it takes very low voltage to trigger NRAM’s switches relative to Flash, so power usage will be lower. With read and write times comparable to SRAM, non-volatility like Flash, and density like DRAM, we believe Nantero stands a good chance of disrupting the markets for embedded memory (eSRAM, eEEPROM, and eFlash) made by companies like Cypress, Hynix, IBM, Infineon, Intel, NEC, Samsung, and Winbond. Ultimately, Nantero could provide a universal stand-alone memory for large data storage and manipulation: one that offers non-volatility, high density, fast responses, and long lifetimes. And all in a package that can be produced using conventional CMOS processes.

THE ATTRACTION OF EMBEDDED MEMORY

While the semiconductor industry continues to push innovation, concerns are growing that the pace of progress will be challenged as shrinking features confront physical limitations. Continuing to reduce line widths to

squeeze more transistors on a postage-stamp sized chip is generating overheating problems as electrons leak out of smaller and smaller devices. It is becoming clear that Moore’s Law – the observation that processor performance doubles every 18 months – will no longer be sustained by scaling alone. Increasingly, combining functions on a single chip will become the driver of performance – and not just at the leading edge where AMD and Intel play, but also for other devices like digital signal processors (DSPs), microcontrollers (MCUs),

build FPGAs, ASICs, DSPs, or MCUs. These include companies like Altera, IBM, Infineon, Intel, LSI Logic, Motorola, Samsung, Texas Instruments, and Xilinx. It is currently shopping its working samples around to both segments of its potential customer base: logic producers who need a more power-efficient and compact embedded memory, and memory producers who would like to find a design that would improve storage capacity, increase read-write speeds, require less space, and reduce power consumption.

► SEARCHING FOR NEW SOURCES OF INNOVATION

TODAY, LEAKAGE IS SUCH A PROBLEM that the power drawn by transistors when they are “off” equals the power usage when “on.” Scaling no longer automatically paves the way to improving device performance and we are instead seeing a move towards combining multiple devices on a single piece of silicon. Advanced Micro Devices (NYSE: AMD, Rating: Accumulate, \$45 price target) introduced dual-core chips with an on-board memory controller to combat the leakage problem and in so doing shifted innovation’s driver from scaling to device design. By building two processing cores together and placing its memory controller on the same chip, AMD showed that it was possible to increase performance while avoiding the overheating problem. Intel quickly followed suit and we are now seeing dual-core processors becoming the norm. By combining logic with other functional devices on a single chip, AMD shows the value of this path to innovation for leading edge MPUs. Its success also suggests the value of similar system-on-a-chip designs for a wide variety of applications from simple MCUs to the most advanced FPGAs. If Nantero’s technology is successful, it may accelerate the performance gains in these applications.

field programmable gate arrays (FPGAs), and application specific integrated circuits (ASICs). Nantero’s NRAM provides an unprecedented combination of capabilities that may help a wide variety of producers improve performance. Those that are first to integrate this technology look to gain a distinct advantage over rivals. Nantero hopes to gain access to the \$4.7 billion embedded memory market by licensing its technology to companies who use embedded memory to

FROM CONCEPT TO COMMERCIALIZATION

Founded in 2001 by a couple of chemistry Ph.D.s from Harvard and a serial entrepreneur with two successful start-ups under his belt, Nantero has a team of semiconductor industry veterans on its board and strategic partnerships with leading materials, equipment, and IC manufacturers. Ultimately, it hopes to replace DRAM, but in the meantime, it is taking direct aim at the market for embedded memory in cell

phones, PDAs, laptops, personal media players, and every other mobile consumer electronic product. It currently hopes that NRAM will see its first design wins in embedded memory applications next year.

Co-founder Thomas Rueckes was studying under Charles Lieber when he discovered a novel approach to building a memory storage device that would rely on mechanical forces in

NANTERO'S COMPELLING BUSINESS CASE:

TECHNOLOGICAL ADVANTAGES:

- Fast as SRAM.
- Non-volatile like Flash.
- Small cell size like DRAM.

MANUFACTURING FLEXIBILITY:

- CMOS-compatible.
- Fewer mask steps than Flash.
- High temp processing OK – BEOL build possible.
- Radiation hard – aerospace and satellite applications.

STRATEGIC PARTNERSHIPS:

- LSI Logic and BAE Systems: CNT-coated wafer processing.
- ASML – patterning with leading edge litho equipment.
- Brewer Science – reliable materials supply.

BUSINESS MODEL:

- License technology to logic and memory manufacturers.
- Earn royalties on CNT solution, supplied by Brewer Science.
- Embedded memory – a low barrier-to-entry insertion point for NRAM.
- High capacity storage devices – second market if scaling goes well.

REMAINING CHALLENGES:

- Increase yields in manufacturing NRAM devices.
- Bits are fast, but need consistency in read/write times for arrays.

addition to the usual electron flows. Rueckes teamed up with fellow chemist, Brent Segal, and entrepreneur, Greg Schmergel, to form Nantero. The company faced many obstacles, not the least of which was devising a solution of CNTs that could be introduced into the sensitive environment of the semiconductor wafer fab. Others had tried to use CNTs in nanoelectronics, but they had tried to grow the CNTs where desired. Nantero took a different approach: they created a solution of CNTs which could be spread on a wafer in a film merely a single nanotube thick. Patterning, using conventional CMOS processes, would then create the desired structures. Nantero relied on the remaining CNT fragments to form the basis for its novel memory switch.

It formed strategic partnerships with leading lithography equipment producer, ASML, and ASIC producer, LSI Logic, to develop CMOS-compatible manufacturing processes for NRAM. Processing bulk nanotubes to eliminate impurities and delivering them in a solvent acceptable to semicon fabs were critical first steps for the team. It took some time, but eventually, Nantero had a CNT solution that could be spun on to wafers, much like conventional photoresist. After removal of the solvent, the remaining CNTs are patterned using standard lithography and etch equipment to form the individual switches. Since its founding, the company has refined the device manufacturing process to reduce the number of mask steps required to embed its NRAM in logic devices. While embedded Flash requires between five to ten additional mask steps, NRAM requires only one.

Because of the inherently robust properties of CNTs – precisely those that have drawn the attention of innovation leaders like IBM – Nantero's NRAM can be built at any stage of IC fabrication. They are impervious to high temperatures, and this provides another advantage over other forms of embedded memory. With this flexibility, NRAM can be built at any stage of chip fabrication — or at

▶ NANTERO QUICK FACTS

FOUNDED: In 2001 by Harvard chemistry PhDs, Thomas Rueckes and Brent Segal, and entrepreneur, Greg Schmergel. Rueckes invented the concept for NRAM as a graduate student working under nanotube pioneer Charles Lieber.

FUNDING: \$31.5 million from venture capitalists Globespan Capital Partners, Charles River Ventures, Draper Fisher Jurvetson, Stata Ventures, and Harris & Harris Group (Nasdaq: TINY; Buy rating, \$19 price target). Additional \$4.5 million in annual US Government funding for collaborative work with Carbon Nanotechnologies Inc. and Southwest Missouri State for three years.

EMPLOYEES: 35, in Massachusetts, Oregon, Virginia, Missouri, and elsewhere.

STATUS: Technology is still in development stage; the company is showing working samples to potential customers for adoption as embedded or stand alone memory.

ADVANTAGES: Memory that is as fast as SRAM, non-volatile like Flash, and as compact as DRAM. Manufactured with CMOS-compatible processes and equipment, but more flexible since impervious to very high temperatures.

BUSINESS MODEL: License technology behind NRAM devices and receive royalties on proprietary CNT material produced and sold by Brewer Science.

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Investor Interest in Diagnostics

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In our opinion, there are a number of reasons behind the disappointing investment environment for diagnostics companies:

- ▶ Products may provide only marginal improvement over existing technologies.
- ▶ Platforms generally allow for a narrow range of diagnostic tests. Since the market adoption of ELISA in the '80s and PCR in the '90s no other detection technologies have been developed with broad applicability.
- ▶ Costs per test are prohibitively high for mass market adoption.
- ▶ Testing requires sophisticated and expensive equipment only available at large hospitals or referral labs.
- ▶ The potential market opportunity is small and dispersed, making it inefficient for companies to build their own distribution channels.
- ▶ Technologies face skepticism from a non-receptive healthcare market.

CHANGE ON THE HORIZON?

We foresee several factors that could help to shift investor perception of the diagnostics sector. The advent of new technologies and drugs and current macroeconomic and population trends combine to create an inviting market for in vivo and in vitro molecular diagnostic tests. A number of nanotechnology companies such as Nanosphere, Nanomix, Kereos, and Combimatrix are developing new diagnostic technologies with the potential to transform the molecular diagnostic market.

THE CASE FOR SMART SPENDING IN HEALTHCARE

In 2004, U.S. healthcare spending reached \$1.87 trillion, or 16% of gross domestic product (GDP). That marks a 94% increase from 1994, when healthcare spending reached \$966 billion (13.7% of GDP).

In coming decades, aging baby boomers and costly chronic conditions such as obesity and diabetes almost certainly will increase healthcare spending. Worse still, it remains difficult to foresee how healthcare spending can be con-

Drug	Company	Monthly Cost
Erbix	ImClone/Bristol-Myers	\$9,600
Avastin	Genentech	\$8,800
Gleevec	Novartis	\$3,816
Herceptin	Genentech	\$3,195
Tarceva	Genentech/OSI Pharmaceuticals	\$2,679

Table 1 : Drug Costs Today. Source: Genentech and The New York Times, February 15, 2006.

trolled in the face of the costly biotechnology drugs already in the market and the likelihood that dozens more will be reaching the market in the near future. Table 1 provides some examples of current drug treatment expenses.

There is widespread concern in the pharmaceutical industry that as much as 50 percent of the drugs on the market are suboptimally utilized due to a variety of reasons which include poor efficacy, low tolerability, toxicity, drug-to-drug interaction, treatment compliance, etc. U.S. spending on prescription drugs was approximately \$285 billion in 2005. If half of all drugs deliver less-than-optimal treatment, as much as \$142 billion in pharmaceutical spending could be better deployed. We believe that the future introduction of less complex and less expensive diagnostic technologies could save the healthcare system billions of dollars through smarter spending on pharmaceutical drugs.

By contrast, the US diagnostic market accounts for only \$24 billion in healthcare costs, as measured by manufacturer sales. Although diagnostics remains a relatively small component of overall costs, the information delivered impacts a very high percentage of every healthcare dollar spent. If future diagnostics technologies promise to help to rationalize pharmaceutical and healthcare spending, we believe that heavy investment in innovation in the diagnostic industry is justified.

Within the diagnostics industry, we believe molecular diagnostics will provide the most promising innovations and valuable contribution for healthcare through improved matching between patient and treatment. We see a compelling case for a higher future ROI for investors in the molecular diagnostic industry.

Because individuals face the prospect of directing more income to healthcare and employers and managed care companies face increasing costs, we believe that both public and private sectors will demand more complete medical justification before initiating expensive and chronic treatment regimens. Thus, we expect increasing demand for diagnostic tests that (i) make earlier and more specific diagnoses, (ii) predict a patient's response to a given drug, (iii) monitor a patient's response during treatment, and (iv) monitor patients after treatment.

NEW DIAGNOSTIC TECHNOLOGIES ARE GETTING READY FOR MARKET ENTRY

The concept of personalized medicine refers to the individuality with which each patient develops a disease and by which each person's disease responds to treatment. This individuality is driven by two factors: (i) the genomic and proteomic characteristics of the particular disease (in the case of cancer or an infection), and (ii) the genomic and proteomic characteristics of the person who suffers from the disease. Molecular diagnostic tests are being developed to detect the key differences among patients that are responsible for the diverse effects of various diseases.

To date, most molecular diagnostic tests are considered to be out of reach to most doctors and patients due to their complexity, cost and our lack of current understanding of the molecular basis of disease. The development of biotechnology drugs, particularly in cancer, has generated an unprecedented understanding of the molecular markers of disease. New biotechnology drugs are being developed concomitantly with their own genomic and

proteomic diagnostic panels. In the future, we expect that a pharmaco-genomic and proteomic justification could be required to validate particular treatment choices.

Advances in the understanding of molecular markers of disease, coupled with laboratory techniques and new technologies, have made possible the market introduction of molecular diagnostic panels. Consequently, the investment community is starting to wake up to the potential of molecular diagnostics and is now assigning higher valuations to companies with viable products in this space. A very encouraging example is Genomic Health (Nasdaq: GJDX; MCAP: \$299 million). The Company has developed a genomic panel that predicts the likelihood of a breast cancer patient's response to Taxotere. Insurance companies are starting to include these tests in their formularies, and we predict this will become the norm as more tests become available at lower cost.

The multiplex detection of nucleic acids and proteins is one area where the promise of nanotechnologies could have a major impact. The advent of such new technologies will allow for the development of multiplexing diagnostic panels with powerful sensitivity at low costs, giving diagnostics companies access to previously untapped markets. Importantly, we believe these tests have the potential to generate a higher margin business for reason we discuss below.

► NEUROMETRIX CASE STUDY

A CASE IN POINT IS THE MEDICAL DEVICE company Neurometrix (Nasdaq: NURO; BUY; price target: \$40). NURO demonstrates the value of technology innovations that create diagnostic systems that reach untapped markets. NURO developed a proprietary automated nerve conduction velocity (NCV) system that reduces the complexity and costs associated with traditional technologies. As a consequence, NCV tests are now available to any primary care physician to perform at the point-of-care and without the need of referral to a specialist or the use of expensive and complicated equipment. The result is the expansion of the NCV market from the current level of 2 million tests per year to a potential of more than 9 million tests per year.

We believe that nanotech-based diagnostic panels will allow local hospitals, doctors offices and nursing homes to routinely perform highly specialized tests at much lower costs. Sample logistic (getting patient samples to the lab) and laboratory labor and logistics represent the vast majority of the cost of

A number of diagnostic companies using nanotechnology are leading the charge. These companies are developing technologies that propose revolutionary new methods of detecting proteins and nucleic acids. The aim is to develop detection technologies without the complexity, cost and time associated with

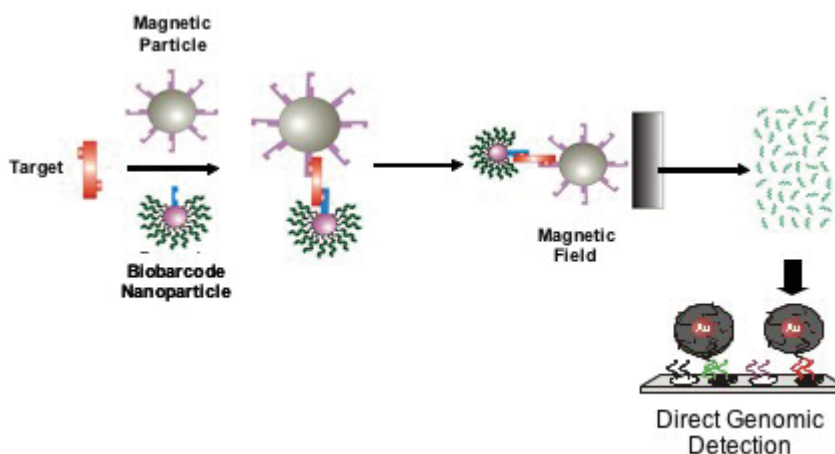


Figure 1. Nanosphere's nanoparticle probe technology. The target molecule is "sandwiched" between a gold nanoparticle and a magnetic particle. When a magnetic field is applied, the oligonucleotides on the surface of the nanoparticle work as biobarcodes which can be read on a DNA array. **Source: Nanosphere.**

obtaining diagnostic information (over 80%). Nano-enabled diagnostics create value by moving testing closer to the point-of-care while minimizing labor costs in the clinical lab. As a consequence, nanotech-enabled devices have the potential to offer broader access to diagnostics and dramatically reduce the costs of obtaining information.

Therefore, we believe start-up diagnostic companies can most vigorously capitalize on the creation of previously untapped markets and the penetration of new clinical settings. These companies could thus command higher valuation multiples if new technologies and applications were to allow them to build business models that maximize operational margins while more tightly controlling their distribution channels. For some companies, however, a simple royalty-based business model could be preferable as when the target diagnostic applications are too large or when the product portfolio consists of multiple applications.

existing laboratory-based methods. Venture capital (VC) backed companies such as Nanomix and Nanosphere are aiming to participate in the in-vitro molecular diagnostics (IVMD) market with nanotech-enabled detection technologies. In addition, companies like VC-backed Kereos and industry leader General Electric (NYSE: GE) are developing novel in vivo molecular imaging diagnostic approaches.

Nanotech-based detection technologies take advantage of certain physical properties of select nanomaterials to design methods for the direct detection of biological targets. For example, Nanosphere's gold nanoparticle-based probes have specific dimensional, optical, thermal, and magnetic properties that enable a robust platform for the direct detection of nucleic acids and proteins. Thus, biomarkers can be detected with simple optical technologies and without the need for complex, time

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Nanotech Takes Aim at the Memory Market

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multiple stages, which would allow stacked memory with even higher densities.

Nantero has also teamed up with leading materials manufacturer, Brewer Science, to create a reliable supplier of its proprietary fab-friendly CNT thin film. Brewer provides credibility and is working with Nantero to scale up the formula to guarantee CMOS-grade consistency in larger volumes.

MARKET POTENTIAL AND BUSINESS MODEL

The embedded memory market includes a variety of memory types such as Flash, SRAM, DRAM, and EEPROM. An extensive study was completed by Semico Research late in 2004 and estimated this market at \$2.7 billion in annual 2003 sales. At that time,

Semico anticipated it to grow to \$3.1 billion in 2004. Semico now expects 2006 sales to hit \$4.7 billion and to reach \$8.7 by 2009 (Semico will be releasing a new comprehensive study later this year). This reflects the strong growth that non-volatile memories have seen over the last few years and ongoing drivers from consumer electronics. NAND Flash sales grew 63 percent last year to reach \$11 billion and sales of all types of non-volatile memory are expected to reach \$24.7 billion in 2006, up from \$20 billion in 2005.

Nantero's business model is based on generating licensing and royalty revenues. It hopes to secure upfront license fees for its NRAM design, non-recurring engineering fees, and ongoing product royalties. Its arrangement with Brewer also provides a royalty on sales

of its CNT solution. Nantero hopes to see its first design win in an embedded memory application during 2007 and to see its design powering products sometime in the next few years. Before it will, however, Nantero must successfully scale up its device and bring the speed of individual bits to entire arrays of its NRAM. It also must conquer the usual yield challenges faced in all new CMOS manufacturing efforts.

These challenges are substantial, but Nantero sees them as surmountable and has made good progress thus far. We expect that users of embedded memory will be taking a close look at NRAM, and would advise makers of embedded SRAM and Flash to keep a watchful eye on the rearview mirror.

Analyst Certification:

We, JoAnne Feeney and Juan Sanchez, hereby certify that the views expressed in this newsletter accurately reflect our personal views about the subject companies and their securities. We also certify that we have not been, are not, and will not be receiving direct or indirect compensation related to our views expressed or any specific recommendations that are contained in this newsletter.

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Rating	Definition	% of companies under coverage with this rating	% within rating category for which investment banking services have been provided in the last 12 months
Buy	Common stock is expected to outperform the market by 15 or more percentage points	62.50%	13.33%
Accumulate	Common stock is expected to outperform the market by 5 to 15 percentage points	6.94%	0.00%
Market Perform	Common stock is expected to perform with the market plus or minus 5 percentage points	30.56%	4.55%
Sell	Common stock is expected to underperform the market by 15 or more percentage points	0.00%	0.00%

The rating system is a guide to expected total return (price plus dividend) relative to the total return of the market on which the stock trades over the next 12 months.

Punk Ziegel NanoFile

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Nanotechnology Could Revive Investor Interest in Diagnostics

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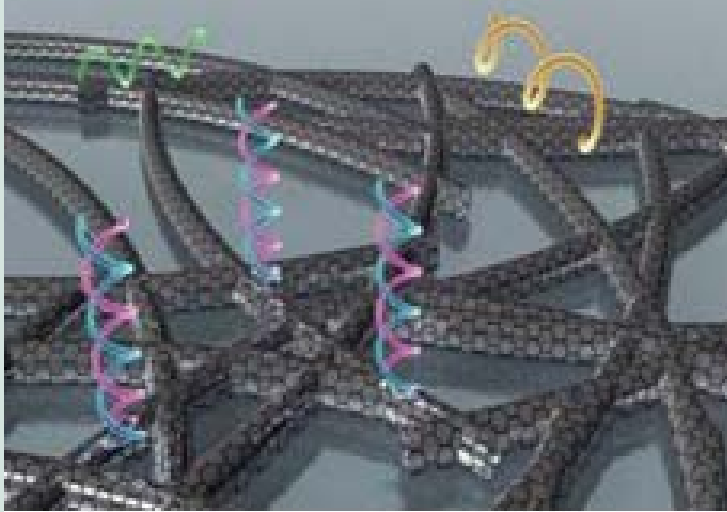


Figure 2. Nanomix's Sensation™ Technology. Net of carbon nanotubes can be functionalized with cDNA or antibodies to detect target molecules.

consuming and costly amplification methods such as polymerase chain reaction (PCR).

Nanosphere is developing its nanoparticle probe technology for ultra-sensitive tests to detect both nucleic acids and proteins. Its Verigene™ System is designed to perform direct genome detection without the need for PCR. This bio-barcode technology allows for the ultra-sensitive detection of proteins several orders of magnitude greater than today's standard ELISA assays. Furthermore, Nanosphere's diagnostic panels allow for the parallel testing of several antigens (multiplexing) at high sensitivities and at extremely low costs. The Company is currently developing clinically relevant diagnostic panels for Alzheimer's disease, prostate cancer, genetic mutations, and other ailments.

Another start-up company, Nanomix, is developing electrochemical detection methods to identify molecular biomarkers. The company functionalizes the surface of carbon nanotubes (CNTs) to generate a change in current flow when the detector contacts the target molecule. While Nanomix's Sensation™

technology is currently being commercialized for industrial applications and is generating revenues, its biological detection applications are in the early stage of development. When completed, its electrochemical nano-detection could allow for portable, inexpensive and ultra-sensitive diagnostic devices.

INVESTOR IMPACT

We believe nanotechnology has the power to bring molecular diagnostics to more patients, more quickly, and at a lower cost. Moreover, we expect this to enhance profitability for next-generation diagnostic companies as compared to those using conventional approaches. We expect companies that use nanotech-based platforms to develop diagnostic tests which reduce the complexity and the high costs associated with current molecular diagnostic technologies (ELISA, PCR) and to bring those directly to patients at the point of care. This nanotech-enabled evolution of molecular diagnostics, like the deployment of second and third generation technologies in other industries, is likely to spur broader market adoption at more reasonable prices.

▶ NANOMIX QUICK FACTS

Located in Emeryville, CA; Nanomix was founded in 1997 as a spin-off from the University of California, Berkeley with technologies from professors Marvin Cohen and Alex Zettl.

Nanomix launched its first product based in its Sensation™ technology in 2005 for the industrial detection of hydrogen.

Future products are slated for the medical breath analysis and bio-detection markets.

\$34.5 million in VC investments to date.

Investors:

Alta Partners

Apax Partners

EnerTech Capital Partners

Harris & Harris Group, Inc

Sevin Rosen Funds

STAR Ventures

▶ NANOSPHERE QUICK FACTS

Located in Northbrook, IL;

Nanosphere was founded in 2001 based on technology contributions from professors Chad Mirkin and Robert Letsinger of Northwestern University.

The Company's Verigene™ product platform is designed for the detection of nucleic acids and proteins at extraordinarily low concentrations. Verigen systems are being commercialized to the research community.

The Company is developing a series of molecular diagnostic tests.

Main Investor: Lurie Investments

Punk Ziegel Nanotechnology Index Update

AMERICAN PHARMACEUTICAL PARTNERS DISGUISES BROADER INDEX GAINS

In the period from September 1, 2005 to February 28, 2006 the Index showed little volatility, while its level fell from 73.53 to 69.73. The decline was led by the 36% drop in American Pharmaceutical Partners (APPX). APPX tends to obscure the performance of the other companies since it comprises 20% of the Index. By contrast, the top four gainers (Arrowhead, Flamel, Ultratech, and Cambridge Display Technology) together comprise 18.3%. For additional insight, we remove APPX and find that over the same period, the remaining sub-Index appreciated by 12%.

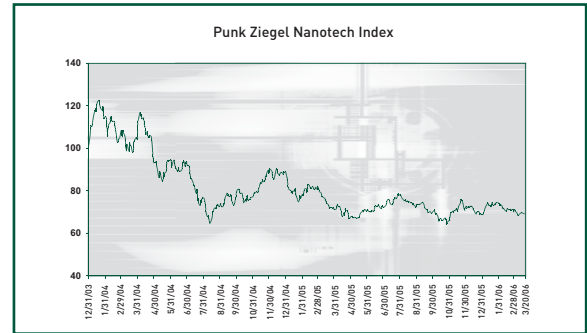
Arrowhead Research (ARWR) was the biggest gainer with an appreciation of 87.3%. The Company announced the appointment of seasoned manager, Dr. Leon Ekchian, as its new president. In our opinion, the addition of Dr. Ekchian increases investor confidence in the commercial prospects of ARWR's subsidiaries, while the ARWR business continues to gain more clarity in the eyes of investors.

Additionally, Flamel (Nasdaq: FLML; BUY; Price target: \$27.50), with a 44.7% appreciation, represented the second biggest gainer of the period. Flamel's most advanced product, Coreg-MR, is being reviewed by the FDA for marketing approval. The Company has announced an impending inspection of Coreg-MR manufacturing facilities by the FDA and a PDUFA date in 2H 2006 and estimates a market launch later in 2006. We expect the Coreg-MR Phase III results to be presented at upcoming cardiology conferences such as the American Heart Association (AHA) meetings in 4Q 2006.

INCREASING TINY'S PRICE TARGET

During the same period, we increased our price target on Harris & Harris (Nasdaq: TINY; Rated: BUY) from \$16.00 to \$19.00. We base this on the Company's success in executing its nanotech investment business model, bringing the total to 27 companies, and its strong cash position of \$96 million at YE 2005. In our opinion, TINY is well positioned to benefit from a possible nanotech IPO market during 2006 and beyond. TINY currently trades at approximately 2.4x our estimated NAV for Q4 2005, a multiple that we believe has considerable upside should IPOs in the space amplify investor attention to nanotechnology. Please see the Note of March 1, 2006 for details.

Winners		Losers	
Arrowhead	87.27%	American Pharmaceutical Partners	-35.65%
Flamel	44.69%	Skye Pharma	-33.24%
Ultratech	36.72%	Nanogen	-26.59%
Cambridge Display Technology	23.54%	Kopin	-25.90%



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SiC ▲ +1.00% Cyt ▲ +3.60% DNA ▲ +1.34% SiGe ▲ +2.70% Si ▲ +1.50% GaAs

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NanoFile