The Research and Science Education Subcommittee of the Committee on Science and Technology of the United States House of Representatives

Hearing on: "Transfer of National Nanotechnology Initiative Research Outcomes for Commercial and Public Benefit"

Testimony of:

William Moffitt

Chief Executive Officer

Nanosphere, Inc.

March 11th, 2008

10:00 a.m.

2318 Rayburn Office Building

I would like to thank you, Mr. Chairman, Ranking Member Ehlers, and Members of the House Research and Education Subcommittee of the Committee on Science and Technology for the opportunity to testify on this critically strategic question.

My name is Bill Moffitt and I am the Chief Executive Officer of Nanosphere, Inc. Nanosphere develops, manufactures and markets an advanced molecular diagnostics platform, the Verigene® System, that enables simple, low cost and highly sensitive genomic and protein testing on a single platform. Our mission is to improve the diagnosis and treatment of disease by enabling earlier access to, and detection of, new and existing biomarkers.

Nanosphere was founded in the year 2000 based upon nanotechnology discoveries made by Dr. Robert Letsinger and Dr. Chad Mirkin at Northwestern University in Evanston, Illinois. Among other achievements, these discoveries made possible the reliable production of functionalized gold nanoparticles that have molecules such as DNA, RNA or antibodies attached to them. These functionalized gold nanoparticle "probes" very specifically bind to nucleic acid and protein targets of interest thereby creating a platform for accurate and sensitive diagnostic applications.

Since its founding, Nanosphere has made continuous enhancements to the original technology advances by coupling the gold nanoparticle chemistry with multiplex array analysis, microfluidics, human factors instrument engineering and software development to produce a full-solution, molecular diagnostics workstation, the Verigene® System. The underlying core nanotechnology imparts characteristics to diagnostic tests that result in a platform that is very sensitive, easy to use, accurate and inexpensive, thus further enabling decentralization of complex diagnostic tests while lowering the cost of such testing.

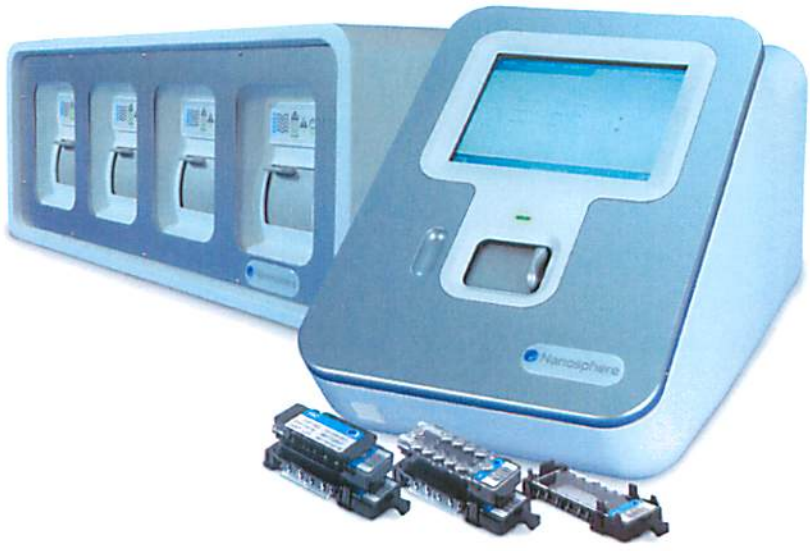

Figure 1. Verigene® System

Nanosphere is now a fully-integrated diagnostics company with established cGMP manufacturing operations, leading edge research and development teams, and veteran customer service and support teams.

In November 2007, Nanosphere received FDA clearance to market the Verigene System and the first warfarin metabolism test ever cleared by the FDA. Warfarin-based anticoagulants, perhaps more commonly known by a leading brand name, Coumadin, are widely prescribed to treat thrombosis, abnormal clotting of blood, which can lead to stroke and other life-threatening conditions. While this is an effective drug, it is also the second leading cause of all adverse drug reactions, second only to insulin. Adverse reactions include excessive internal bleeding which can lead to complications including hemorrhagic stroke and death. According to the FDA, tens of thousands of such adverse reactions occur each year. The Nanosphere warfarin metabolism test, which detects certain genetic mutations in patients, is used to guide appropriate initial dosage to ensure safety in patient care. This is one example of a complex genetic test that must be readily available to physicians on a timely basis. This is just one example of how nanotechnology is addressing significant issues in health care.

These nanotechnology probes also create an ability to detect proteins, the building blocks and warning signs of the body, at a level at least 100 times more sensitive than current technologies, which may enable earlier detection of and intervention in diseases associated with known biomarkers and may also enable the introduction of tests for new biomarkers that exist in concentrations too low to be detected by current technologies. We are currently developing diagnostic tests for a variety of medical conditions including cancer, neurodegenerative, cardiovascular and infectious diseases, as well as pharmaco-genomics, or tests for personalized medicine.

There is a growing demand among laboratories to implement molecular diagnostic capabilities but the cost and complexity of existing technologies and the need for specialized personnel and facilities have limited the number of laboratories with these capabilities. We believe that the Verigene System's ease of use, rapid turnaround times, relatively low cost and ability to support a broad test menu will simplify work flow and reduce costs for laboratories already performing molecular diagnostic testing and will allow a broader range of laboratories including those operated by local hospitals, to perform molecular diagnostic testing.

Our effort at Nanosphere to improve diagnostic testing and provide for earlier detection of diseases ranging from cancer to Alzheimer's to cardiovascular disease is but one example of the potential for nanotechnology. Developments in science support the prospects for nanotechnology to have a significant impact on many industries. Nanotechnology has the potential to shift markets in a global economy and replace or greatly modify existing leadership positions. As such it represents both an opportunity and a challenge for American competitiveness.

The U.S. currently leads in science, but could lose the commercialization race. While we are bearing the burden of fundamental research a significant global investment in development programs to commercialize nanotechnology is occurring in Asia. In fact, when purchasing power and exchange rates are accounted for, Asia now leads the world in nanotech funding.

In decades past, large corporations had significant internal translational research efforts, but the landscape has changed. Investments tend to be made in shorter term improvements to existing product platforms, while relying upon acquisitions of start-up companies to provide longer term replacements for core competencies. It is a question of risk adjusted capital investment.

At the same time, start-up companies struggle to attract significant venture capital funding until they have established the commercial viability of their technologies. As a result, much of nanotechnology's potential remains locked in the translational phase of its life cycle. We have solid fundamental research but inadequate effort is being made to translate that fundamental science to specifically address important societal and economic problems. Nanoscience needs to be directionally focused to enable fundamental improvements in a number of industries ranging from energy to health care to telecommunications and computing technology.

With that as context for my testimony, I would like to share with you my thoughts on the Transfer of NNI Research Outcomes for Commercial and Public Benefit, specifically addressing four questions:

1. What are the hurdles to the commercialization of nanotechnology?

    a. First and foremost, lack of early stage capital for cutting-edge, translational research. To go from lab to product, a nanoscience concept must first find capital to develop the core science into a "platform technology." Such platform technologies are usually novel materials or material combinations that have the ability to generate multiple products. It takes extensive capital to develop the platform and demonstrate its potential and commercial viability. This includes being able to reliably and cheaply produce the platform, integrating the platform into a specific application, tailoring it to improve the application's efficiency and then scaling the manufacturing of the platform. Only at this point can commercial efforts generate revenue and profits to reinvest for commercialization of additional applications. The significant amount of capital required and the early-stage, high-risk nature of translating technology from lab to market makes it difficult to raise capital for emerging nanotech businesses. Many great nanotech scientific discoveries fail to attract the extensive capital required for commercialization and for this reason the gap between the lab and product prototype is often called the "valley of death."

b. Second, lack of a good mechanism to balance focus on multiple, high-potential technologies. The government should focus more spending on translational work or goal-oriented development programs with an appropriate balance on scientific research. To realize the societal and economic benefits of nanotech, government and private sector funds need to focus on the nanotechnologies with the greatest potential applications. Quite often capital is redundantly spread across too many organizations each of which is aiming for the same target. As an example, we still see requests from the military for the development of a biosecurity testing platform that Nanosphere has already developed and provided under contract. The government needs to develop methods to address a broader spectrum of nanotechnologies and control redundant spending. Spending should factor in the existing investment in an area and the potential of the technology to lead to an important product.

c. A third hurdle to commercialization of nanotechnology is difficulty in finding technical talent. Nanotechnology is unique in its need for highly-trained scientists from multiple disciplines. Since a given nanotechnology can enable multiple applications, nanotech companies find themselves needing PhDs in both the underlying nanotechnology and in the specific area of application. These highly-paid, high-quality jobs are difficult to fill because of the well-documented decline in STEM graduates. In addition to PhDs, nanotech companies also need trained and skilled laboratory technicians. There are currently very few technical training programs producing workers that fill this need. We can address both issues by developing vocational curricula and deploying them in community colleges and encouraging internships by high-school and college students that expose them to nanotech as a career.

2. What federal programs or activities can help to bridge the "valley of death" successfully? How effective have the SBIR/STTR and ATP programs been in this regard?

a. We must find a way for government funds to bridge the "valley of death" where promising science is unable to attract sufficient capital to bridge the gap to corporate sponsorship. This gap is in part a result of the fact that corporate America is more interested in developing and improving already proven technology platforms and the government is largely focused on fundamental research rather than goal-oriented research. Countries such as Taiwan, Korea and China regularly leverage America's investment in fundamental research by using government sponsored programs to directly fund companies to commercialize that research and develop products. America's position in the global market may rest on retaining leadership in nanotechnology. To close the "valley of death," we must invest more in goal-oriented research and in helping translate research from the lab into the marketplace.

Conceptually programs such as SBIR/STTR and ATP have helped in this process, but often these grants fail to provide a sufficiently significant amount

of capital. Up to the point of the first product launch of our nanotechnology-based diagnostic platform Nanosphere had spent approximately $110 million in "high risk" capital, with only ~$7 million coming from government funding sources including TSWG, SBIR/STTR grants and others. However, if I subtract the biosecurity contract funding, the total government support has been less than $2 million.

While much of the early work on the science was funded through NIH and NSF in a university research setting, those expenses are minor in comparison to the cost of platform development and commercialization. What SBIR/STTR and TSWG funding did do was provide a certain element of validation for private sector investors. To some degree the competitive process of grant review and award provides third party verification of the potential value of the science, especially in early development phases where capital is at the highest risk.

What the government can do to provide additional incentive for private sector investment is to develop a program of tax and investment credits which will help mitigate risk for early capital and provide additional incentive for investments directed at goal oriented research and development programs. Focusing programs at specific problems enables the government to broadly direct investment while placing the onus of efficiency and effectiveness of investment on the private sector. Since investors use a competitive, market-driven mechanism to select companies, these tax and investment credits will benefit those companies with the most potential to produce meaningful applications.

3. Are there areas of focus for commercialization that will position the nation for leadership in nanotechnology?

    a. While there are areas of focus that will position the U.S. for leadership, it also makes sense to support goal oriented research and development more broadly beyond today's primary focus on basic science and discovery. Such goal oriented development programs will translate much of this new science into platform technologies that will likely impact several industries.

    b. Clearly there are two areas of focus where the U.S. has strong potential, energy and health care. Our growing energy needs are evident and in health care we are both the largest provider and largest consumer in the world. Historically, health care has not scaled the way other industries have, driven by innovations in technology. Where is the leverage? Nanotechnology holds promise for impacting every aspect of medical care from research to diagnostics to imaging to therapeutics.

    In my own company we have taken basic science from Northwestern University's Nanotechnology Institute and converted it into a diagnostics

platform that delivers three distinct value propositions: 1) the ability to move complex genetic testing into mainstream medicine, 2) the prospect of earlier detection of diseases such as cardiovascular disease and cancer as nanoparticle probes improve detection sensitivity by orders of magnitude and 3) the prospect for developing tests for diseases where none exist today as biomarkers of active disease are undetectable by current technologies. Imagine a future where economical, widely available genetic testing provides the architectural game plan for personalized medicine and a panel of ultra-sensitive biomarker tests specifically tailored to an individual monitor for the earliest on-set of disease, a timeframe when therapies are most effective.

4. Are there any barriers to commercialization imposed by current intellectual property policies at NNI supported user facilities, and if so, what are your recommendations for mitigating these barriers?

    a. The issues for user facilities are:

        i. Availability and proximity – Although the user facilities are geographically dispersed, they are not always proximate to business users. Furthermore, there is no single source of data on the services these facilities provide or the equipment they have, making it difficult for many companies to access them efficiently. An effort should be made to create a central database where potential users can see all facilities and their available services and equipment and to create new facilities in locations where nanotechnology centers of excellence are emerging and translational development can be most effectively developed. As an example Chicago does not have a user facility in the National Nanotechnology Infrastructure Network (NNIN) in sufficiently close proximity even though the surrounding area has many nanotech companies.

        ii. Cost and intellectual property – These facilities charge "full cost recovery" which means a significant overhead burden (not related to the facility or service itself) is layered onto the direct cost of the service provided, typically making the cost of use significantly higher than the value of the service provided. In addition, the facilities need strong assurances that protect companies with regard to IP and trade secret information that may develop.

        iii. Support services – Most start-ups do not have personnel that are trained and proficient in using these facilities. Users need support personnel to make use of the facilities or must invest significant time and effort into educating facility personnel prior to engaging for what may ultimately be short-term projects. This may also add to the concern for protection of confidential information and intellectual

property, especially in circumstances where the facility sponsor may try to claim joint ownership of IP generated during the use of the facility. These issues make the use of these facilities cost-inefficient for most businesses.

Conclusion

The U.S. must retain its leadership position in this industry-changing technology which has the potential to realign global competitiveness. The U.S. government must set the "gold standard" in supporting an efficient and productive climate, not only for discovery, but also for commercializing nanotechnology innovation. Not only will such an initiative enhance American competitiveness, but it will also help us address significant issues that will impact generations to come.

Thank you for the opportunity to voice my concern and share my perspective with the committee.