Testimony of

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Before the

U.S. Senate Subcommittee on Science, Technology, and Innovation

Hearing on

National Nanotechnology Initiative: Charting the Course for Reauthorization

April 24, 2008

Chairman Kerry, Ranking Member Ensign, and Members of the Subcommittee, I would like to thank you for the opportunity to testify on the reauthorization of the National Nanotechnology Initiative.

My name is Dr. Anita Goel, and I am the Founder, Chairman, and Scientific Director of Nanobiosym, Inc. and the Founder, Chairman, and CEO of Nanobiosym Diagnostics, Inc. Nanobiosym was founded as an idea lab and research institute to innovate at the convergence of physics, medicine and nanotechnology. Nanobiosym, and its commercial partner Nanobiosym Diagnostics, have been privately developing *Gene-RADAR*®, a portable nanotechnology-enabled platform that can rapidly and accurately detect genetic fingerprints from any biological organism. The company's vision is to give patients worldwide real-time access to their own diagnostic information via low-cost handheld devices. We are based in Medford, Massachusetts.

I first began working as a scientist in the field of nanotechnology over fifteen years ago at Stanford University – well before the term "nanotechnology" had become a buzz word. I simultaneously trained as both a physicist and physician, with my PhD in Physics from Harvard University and my MD from the Harvard-MIT Joint Division of Health Sciences and Technology (HST). For almost five years now, I have been a nanotechnology entrepreneur as the Founder, Chairman, and CEO of Nanobiosym and Nanobiosym Diagnostics. We are developing commercial products targeted for global markets – in both the developed and developing worlds.

What is Nanotechnology?

Nanotechnology to me is the ability to probe and control matter and systems on increasingly finer scales, at the nanoscale (10^-9 m) and smaller. This is important because it gives us a new level of control over matter. Nanotechnology is a platform science which combines several traditional fields such as physics, chemistry, biology, and medicine. The applications that stem from these capabilities likewise cut across several different sectors from medicine and energy to the environment and materials science. For example, the ability to control the assembly and arrangement of atoms and molecules in a nanomaterial could give it the durability of steel and the weight of plastic.

Nanotechnology provides a platform for innovation across conventional boundaries of science, technology, and commerce. Furthermore, by its intrinsic multidisciplinary nature, it fosters collaboration across conventional political and economic boundaries.

Nanobiosym and the National Nanotechnology Initiative

Nanobiosym has been the direct beneficiary of the National Nanotechnology Initiative. Without the resources that the Initiative brought to bear – not only funding, but also coordination and a sense of national priority – Nanobiosym would not be where it is today. We have been fortunate to work with several of the agencies participating in the Initiative, and have received multiple rounds of competitive funding grants from DARPA, AFOSR, Phase I and Phase II SBIR funding from DOE, and now more recently were awarded a defense contract from DTRA as some of our technology platforms transitioned from the pure R&D stage to the more applied or prototyping stage.

As the Subcommittee considers how best to update and improve the Initiative, I hope that our experience as an emerging nanotechnology company (in moving across the gamut from science and technology innovation, to proof of concept development and developing commercial products for global markets) will help identify what has worked well and what could be improved to encourage other companies like us.

The Need for Reauthorization

As Congress begins to consider reauthorizing the National Nanotechnology Initiative, it is important to understand that because the original authorization was so successful, the nation's nanotechnology landscape dramatically changed in the last five years. The 21st Century Nanotechnology Research and Development Act focused primarily on basic research. This led to dynamic growth in America's nanotechnology research infrastructure primarily in academic settings, and sowed the seeds of nanotechnology commercialization throughout the country.

Today, five years later, we are beginning to see the results of this initial investment, as nanotechnology-enabled products start to enter the marketplace across the spectrum of industry sectors, from water purification to materials engineering to healthcare. While the success of the first five years gives us great hope, however, I cannot impress upon the Subcommittee enough that the growth of the next five years could be exponential. Building on the success of the National Nanotechnology Initiative's first five years, the United States has a historic opportunity to drive nanotechnology to maximize its impact on global challenges, including health, environment, energy, and even building the new global economy.

The reauthorization of the National Nanotechnology Initiative should focus on four new areas in addition to basic research:

1. improving nanotechnology education, which will supply a qualified workforce for the American and global nanotechnology economy;
2. bridging the gap between research and commercialization, which will help America drive the global nanotechnology revolution;

3. addressing environmental, health, safety, and other global challenges, which will ensure that we can enjoy the many benefits of nanotechnology while addressing any risks that may arise; and
4. bringing emerging technologies into emerging global markets.

Each of these four areas has a direct impact on my company. Progress in each will enable Nanobiosym to bring its lifesaving products to market faster, to expand and provide quality jobs for more people, and to market our products to global markets in both the developed and developing world.

A Roadmap for Harnessing Nanotechnology to Drive the New Global Economy

1. Nanotechnology Education

If America is going to compete effectively in the global nanotechnology revolution, we need a highly skilled and qualified workforce. We need scientists, engineers, and technicians who have a vision for nanotechnology, seek to innovate with it, and are capable of working at the nanoscale. We need professors and teachers who can educate about the nano world and we need business professionals who can turn the scientists' work into useful products. It is already difficult to meet the demand for PhDs with nanotechnology backgrounds, and that demand will only increase in the coming years.

We need to spark interest in nanoscience, starting in grade school. We need to build a nanotech pipeline in education which will allow for a steady stream of qualified personnel to supply our labs and companies.

Nanotechnology education, like nanotechnology research, is necessarily multidisciplinary. Because nanotechnology spans physics, materials science, chemistry, and biology, it needs to be taught throughout the science curriculum. And like other subjects, nanotechnology is best learned by doing. Programs that improve access to basic nanotechnology tools will help inspire a new generation of students to pursue careers in science because they will be able to see firsthand nanotechnology's potential.

Our education system must start transcending conventional boundaries between academic disciplines, between academic and corporate training programs, and between US and international training experiences. I would suggest the creation of more international exchange programs. Just as other countries send their students here, we should start sending our people around the world to be trained not only in nanotechnology but its broader international context.

The reauthorization bill will be an excellent investment in America's future if it promotes nanotechnology education from grade school through graduate school. If it does not, we will continue to rely in the short term on foreign science students who will often end up returning to their home countries to compete against us after completing their studies.

2. Bridging the Gap Between Nanotechnology Research and Commercialization

As the Members of this Subcommittee know, America's competitiveness in the global market is being tested in the field of nanotechnology, where Russia, China, Japan, the European Union, and other nations are making major investments in translating basic research into marketable nanotechnology products. Often, foreign governments are pursuing a strategy of letting American researchers do the basic science, then using their resources to commercialize that research and gain the economic benefit. Having invested in the early days of nanotechnology research and innovation, we should not miss the opportunity to fully commercialize our own research.

Programs such as Small Business Innovation Research, Small Business Technology Transfer, and the new Technology Innovation Program are vital mechanisms for bringing technology out of the lab and into the marketplace. They provide needed resources and expertise to emerging small businesses, and they help bring new technology and new jobs into existence. They bridge the "valley of death" that lies between basic research funding and late-stage commercial funding – a valley that would otherwise swallow many more promising companies. As the Subcommittee drafts the reauthorization legislation, I urge you to ensure that these programs play a major part in the bill.

In my own experience, programs like SBIR have enabled companies like ours to stay focused on more disruptive innovations even when they are not the lowest hanging fruit in terms of revenue generation. In practice, such programs keep American innovation at the cutting edge as we continue to meet real-time market needs.

Rapid commercialization is important, but goal-oriented research also will help accelerate the path to market for nanotech companies. Many emerging countries are focusing on this strategy to leapfrog themselves into significant roles in the global economy. For example, countries like Taiwan have determined that, although they may not be able to challenge the United States across the board, they can compete effectively if they concentrate their resources. By conducting goal-oriented research in a key area such as electronics or display technologies, they can achieve a strong position in those markets.

We can do the same thing. Already, we have had tremendous success with goal-oriented research in cancer treatment and other health-related areas. Identifying and pursuing other key goals, such as nanomedicine, energy, electronics, or water purification, will help ensure that we are getting the most for our research money.

As someone who practically embodies the concept of "multidisciplinary research," I would encourage the Subcommittee to see to it that goal-oriented research centers cross traditional scientific and agency boundaries. The National Science Foundation and the Department of Energy should be working together; NIST should be working with EPA; and so forth. I have seen the beginnings of such multidisciplinary research under the current National Nanotechnology Initiative, and the results are indeed encouraging. I see this in my own company every day, and I know it works.

Goal-oriented work and cooperation will go far to expedite commercialization and provide a more efficient path to market for many businesses and products. I caution the Committee, however, not to get trapped by lesser goals while losing sight of the bigger picture. It is one thing to make products based on nanotechnology research; it is another to build a nanotechnology economy. The goal-oriented nanotech research of competing economies is understandable given their resources. But it is one thing to be simply the supplier of a bumper, or a headlight, or a mechanical part for an automobile; it is another thing to build an economy based on the mobility the automobile enabled, which spawned multiple new industries and employed millions. So it could be with nanotechnology.

It is true that goal-specific research will be important, as will support for commercialization and collaboration between agencies. It will be this understanding of the nano-based economy that will differentiate us from our competitors and allow us to make the best decisions about where to invest our resources. This understanding will also enable us to take a fresh approach to American leadership in the new global economy.

3. The Broader Impact of Nanotechnology on Environmental, Health, Safety and other Global Challenges

A comprehensive, strategic approach to understanding the environmental, health, and safety effects of nanotechnology is a necessary component of any federal plan at this point. With nanotechnology products entering the commercial market, it is important that we know how nanoparticles behave in the body and in the environment. Just as important is the need to communicate with consumers so that they understand the efforts that are underway to determine and address any risks that may exist. The last thing that any nanotechnology company wants is for a lack of safety data to scare consumers into staying away. The field has learned the lessons of the genetically-modified food debacle.

That said, however, Nanobiosym's experience represents a different part of the issue. Amid the concern about potential negative environmental, health, and safety impacts, it is easy to forget that nanotechnology can be much more of an environmental, health, and safety solution than a problem. For example, Nanobiosym's products will improve health both here and in the developing world by rapidly diagnosing infectious disease. Soon, we plan to expand into water and food testing. When it hits its stride, my company will be an environmental, health and safety solution, not a problem.

Although I am proud of our technology and the contribution it will make, many other nanotechnology companies are making similar contributions to environmental, health, and safety issues. From fuel cells to LED lights, from cancer treatments to antibacterial surfaces, and from strong composite materials to aircraft metal fatigue sensors, nanotechnology products are beginning to clean up the environment, cure people and keep them healthy, and save lives by preventing accidents. These trends will only accelerate as nanotechnology becomes more widespread.

4. Bringing Emerging Technologies into Emerging Global Markets

I envision that the new global economy will take shape as the economies of major nations become more interdependent and intertwined via science, technology, and commerce. Nanotechnology by its very multidisciplinary and international nature is thus likely to play a major role in driving the new global economy.

Nanotechnology will spur American entrepreneurs to think and act even more globally. As Americans, we should take a bold step towards global leadership in the nanotechnology revolution by engaging other players around the world and also by embracing global challenges (such as the energy crisis, global health, and the environment) as our own including those of the developing world. Together we should focus on using our best scientific and technological tools to solve real-world problems.

For example, at Nanobiosym we have developed a technology platform that has both biodefense applications and clinical diagnostic markets here in the US as well as in the developing world. The very nature of the way innovation and commercialization is proceeding in nanotech enables us to reach out to a global market. For example our product, because of its portability and small size, has a large potential in the developing world. Similar to the cell phone industry which has made a disruptive impact on telecommunications in emerging markets, there are six billion people on Earth and everybody gets infected at some point in their life. If we can make our products cheap enough we can improve global healthcare as well as cater to the needs of a growing multibillion-dollar market.

Conclusion

I would like to thank you, Chairman Kerry, Ranking Member Ensign, and the Members of the Subcommittee once again for the invitation to testify today, and for your leadership in working to ensure that America can harness the nanotechnology revolution to not only revitalize its economy but also drive and help shape the new global economy. Building on the success of the National Nanotechnology Initiative's first five years, the United States has a historic opportunity to drive nanotechnology to maximize its impact on global challenges. The economic and humanitarian benefits of driving this nanotechnology revolution will be tremendous, and the reauthorization of the National Nanotechnology Initiative will go a long way towards putting America at the forefront of this global revolution.

As the CEO of an emerging nanotechnology business with global aspirations, I am certainly grateful for the support.