TESTIMONY

of

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to the

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Introduction

On behalf of Northwestern University, I would like to thank Chairman Terry, Ranking Member Schakowsky, and the entire Subcommittee on Commerce, Manufacturing, and Trade for the opportunity to participate in today's hearing entitled "Nanotechnology: Understanding How Small Solutions Drive Big Innovation." I am the Henry Wade Rogers Professor at Northwestern University, with appointments in the Departments of Biomedical Engineering, Chemistry, and Cell & Molecular Biology. I direct a research group that develops nanomaterials for a broad range of biological and medical applications, including screening technologies used in drug discovery, materials coatings used in medical devices, and devices used to diagnose disease. I have also been involved in the translation of University-based research to technology companies, having Co-Founded SAMDI Tech, 480 Biomedical and Arsenal Medical and having served as a member of several Scientific Advisory Boards of nanotechnology companies. I appreciate the opportunity to share my experiences and perspectives on several topics related to the commercialization of research and engineering advances in nanotechnology.

Fundamental Research

The nanotechnology field has been enabled by the development of methods that can prepare materials having tiny dimensions—in the range of 1-100 nanometers—and by the development of advanced tools that can characterize the structures and properties of these materials. We now know that the properties of a material can vary widely as its dimensions change, and we understand how to engineer nanomaterials with tailored properties, and in many cases with properties that do not exist with traditional materials. The availability of materials having novel properties is having a major impact in all technological areas. In medicine, nanotechnologies will allow more predictive diagnosis and treatment of diseases, including Alzheimer's, cardiovascular disease and cancer. In electronics, nanotechnologies

have already radically increased the computational power of devices all around us, and in energy nanotechnologies are important to realizing practical power for electric vehicles. Indeed, nanotechnology is a broad-based field that, unlike traditional disciplines, engages the entire scientific and engineering enterprise and that promises new technologies across these fields.

The National Nanotechnology Initiative recognized this transformative potential of nanoscience and the importance of having each of the funding organizations participate in the development and commercialization of nanoscience. By requiring each of the federal agencies to commit a fraction of their budgets to developing the nanosciences, the NNI has brought about the creation of a national infrastructure for nanoscale science and engineering. At my Institution, for example, Northwestern University created the International Institute for Nanotechnology. This Institute operates across many academic Departments and has built a leading community for nanotechnology, having attracted leading faculty to our campus and having trained many students who are now leading faculty members across the globe. Indeed, a good fraction of our Nation's universities have created units devoted to nanoscience and these have collectively given the United States a strong infrastructure and a leadership position.

Commercialization

The Federal investment in nanotechnology that the NNI started 15 years ago has rapidly led to a nanotechnology industry. At Northwestern's IIN, for example, we have seen more than 25 companies started by our faculty and these have raised greater than 700 M in private funding. These companies include Nanosphere, which is a public company that sells a system for clinical diagnostics, AuraSense Therapeutics, which is a private company that is developing nanoparticles for gene therapy, and SAMDI Tech, which I Founded in 2011 and which is now a

profitable company that provides assay services to the pharmaceutical industry. These are just a few of many examples across the United States.

At the same time, there is wide recognition that a lack of pre-defined regulatory processes still presents challenges to the commercialization of nanotechnologies. Regulations for safety and environmental impact should recognize that one set of standards will not optimally apply to products in each industry and therefore the existing regulatory agencies should be given responsibility to develop best practices in their sectors. Those in the semiconductor industry, for example, are more defined than those in the therapeutics area. Here, a public-private consortium may be important to defining efficient and effective standards that benefit the industry. Similarly, the manufacturing methods and standards that will be important to producing products in several areas are still not well-developed and therefore introduce substantial risk in advancing a prototype device to a manufacturing process. Here again, a public-private partnership—based on the National Network for Manufacturing Innovation Centers—can be effective at advancing the industry as a whole.

While there are substantial resources directed towards fundamental discovery and also substantial private capital available for companies that are close to having products on the market, there is comparatively less investment available for bridging these two activities and in creating small companies that aim to validate a prototype or a manufacturing process. Policies that promote this transition—which is particularly challenging for first-time entrepreneurs—could be important, including streamlined access to a SBIR contract for those nanotechnology grantees that have filed a patent application. Finally, the time that separates fundamental discoveries and translation into a company is shorter in nanotechnology than in other fields, and this change has highlighted a challenge with our patent system. It typically requires five years

to obtain a patent, which means that new companies do not have patent protection as they move towards introduction of a product, which encourages competition from competitors outside the United States.

GLOBALIZATION

The scientific and economic promise of nanotechnology has been recognized by our foreign partners and competitors. Recent trends in those regions point to challenges that the United States has not faced before. First, Governments in Europe and Asia continue to make targeted investments in nanotechnology, with annual growth rates that are in the double digits and that have approached 50% in China. Second, the culture and infrastructure for rapidly translating academic research into companies has changed dramatically over the past decade in Europe and Asia and researchers in those regions are now quite effective at starting technology companies. Finally, we are now seeing the recruitment of our best scientists to full-time and part-time research positions in other countries. The globalization of science has many benefits, but it is clear that it will also level the global playing field for translating basic research into commercial entities and will dilute the positive impact of nanotechnology on our economy.

CONCLUSIONS

In conclusion, the creation of the National Nanotechnology Initiative in 2000 has been successful in advancing fundamental discoveries across the science and engineering disciplines, in training a new generation of skilled scientists in these areas, in translating discoveries to commercial entities and in realizing the first nanotechnology-enabled products. Current challenges to realizing the broader economic promise of the nanotechnology industry include the development of strategies to ensure the continued investment in fundamental

research, to increase the fraction of these discoveries that are translated to technology companies, to have effective regulations on nanomaterials, to efficiently process and protect intellectual property and to ensure that within the global landscape, the United States remains the leader in realizing the economic benefits of the nanotechnology industry. I thank you for your time, attention and service to the country, and am happy to answer any questions that you may have.