U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON ENERGY AND COMMERCE

March 13, 2017

TO: Members, Subcommittee on Digital Commerce and Consumer Protection

FROM: Committee Majority Staff

RE: Hearing entitled "Disrupter Series: Advanced Materials and Production"

I. INTRODUCTION

On Wednesday, March 15, 2017, at 10:15 a.m. in 2322 Rayburn House Office Building, the Subcommittee on Digital Commerce and Consumer Protection will hold a hearing entitled "Disrupter Series: Advanced Materials and Production."

II. WITNESSES

- James M. Tour, Ph.D., T. T. and W. F. Chao Professor of Chemistry, Professor of Computer Science, and Professor of Materials Science and NanoEngineering, Smalley Institute for Nanoscale Science & Technology, Rice University;
- Keith Murphy, Chairman and Chief Executive Officer, Organovo Holdings Inc.;
- Shane Weyant, Chief Executive Officer and President, Creative Pultrusions, Inc.;
- Hota GangaRao, Ph.D., Maurice A. and Jo Ann Wadsworth Distinguished Professor of CEE, CEMR, Director, Constructed Facilities Center, Director, Center for Integration of Composites into Infrastructure, West Virginia University; and,
- Afsaneh Rabiei, Ph.D., Professor, Department of Mechanical and Aerospace Engineering, North Carolina State University.

III. BACKGROUND

The Disrupter Series continues in the 115th Congress as an opportunity for Members of the Subcommittee to learn about emerging technology and their applications in the marketplace. The series continues today with an examination of materials, compounds, and processes that are the building blocks for disruptive applications in the electronics, automotive, airline, energy, and health care industries to name a few. Emerging research and development in materials science have improved upon and been incorporated into solutions provided by more traditional materials in various applications from infrastructure to health care. These solutions are advancing innovation and safety in the U.S.

According to the Bureau of Labor Statistics, there are 25,300 materials engineers in the U.S.[1] There is expected growth in the number of jobs through 2024 in the biomedical engineering field and steady job opportunities in other industries manufacturing efforts including aerospace engineering.[2] As the conversations about infrastructure investments continue, there are estimates of six percent growth in public sector infrastructure investment by 2020.[3]

There are a number of fascinating materials that present an instructive case study in the opportunities and challenges in moving from discovery to commercialization. For example, in 2002, Andre Geim, physics professor at the University of Manchester, discovered the first two-dimensional material: graphene.[4] Over the course of several years, Dr. Geim and his team discovered the properties of this one-atom thick material. Studies also found that the conductivity of graphene could be controlled in a similar manner to silicon—opening up a number of applications in the technology industry.[5] In 2010, Geim and Konstantin Novoselov won the Nobel Prize in Physics "for groundbreaking experiments regarding the two-dimensional material graphene."[6]

The potential applications for graphene span industries including automotive, electronics, health care, and textiles.[7] Some of the hypothetical applications include night-vision contact lenses,[8] super silk for body armor,[9] and metamaterials (materials invisible at certain wavelengths).[10] Earlier this year, researchers at the Massachusetts Institute of Technology published findings a 3-D form of graphene that "can have a strength 10 times that of steel" that could be used in bridges or filtration systems for water.[11]

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[1] https://www.bls.gov/ooh/architecture-and-engineering/materials-engineers.htm
[2] *Id.*
[3] Leslie Thompson, "How to Invest in Infrastructure After the Election" US News & World Report, Nov. 22, 2016, available at http://money.usnews.com/money/blogs/the-smarter-mutual-fund-investor/articles/2016-11-22/how-to-invest-in-infrastructure-after-the-election.
[4] John Colapinto, "Material Question" The New Yorker, Dec. 22 & 29, 2014, available at http://www.newyorker.com/magazine/2014/12/22/material-question.
[5] Id. (Colapinto)
[6] https://www.nobelprize.org/nobel_prizes/physics/laureates/2010/
[7] *See* Ian Sample, "Five wonder materials that could change the world" The Guardian, April 15, 2014, available at https://www.theguardian.com/science/2014/apr/15/five-wonder-materials-graphene-shrilk-spider-silk-stanene-could-change-world; "ORNL demonstrates first large-scale graphene fabrication" EurekAlert!, May 14, 2015, available at https://www.eurekalert.org/pub_releases/2015-05/drnl-odf051415.php.
[8] James Vincent, "Contact lenses with night vision could be on the way thanks to graphene breakthrough" Independent, March 21, 2014, available at http://www.independent.co.uk/life-style/gadgets-and-tech/contact-lenses-with-night-vision-could-be-on-the-way-thanks-to-graphene-breakthrough-9208212.html.
[9] Mariella Moon, "Graphene-fed silkworms can spin super threads" Engadget, October 12, 2016, available at https://www.engadget.com/2016/10/12/graphene-super-silk/.
[10] Ian Sample, "Five wonder materials that could change the world" The Guardian, April 15, 2014, available at https://www.theguardian.com/science/2014/apr/15/five-wonder-materials-graphene-shrilk-spider-silk-stanene-could-change-world.
[11] David L. Chandler, "Researchers design one of the strongest, lightest materials known" MIT News Office, Jan. 6, 2017, available at http://news.mit.edu/2017/3-d-graphene-strongest-lightest-materials-0106; Timothy J. Seppala, "MIT's 3D graphene is ten times stronger than steel" Engadget, Jan. 7, 2017, available at https://www.engadget.com/2017/01/09/mits-3d-graphene-is-ten-times-stronger-than-steel/.

There are many material discoveries that have changed the face of the American economy including the combination of steel with steam technology in the industrial revolution,[12] aluminum's fundamental impact on the aerospace industry,[13] advanced plastics and injection-molding machines,[14] and hydrolic fracturing[15] just to name a few. In 2016, U.S. manufacturers produced 79.6 billion pounds of resin.[16] Advancements in nanofiber fabrication devices offer potential applications in sterile bandage application and "spray-on sportswear."[17]

The federal government is involved in research and development efforts for innovative technologies. For example, the Department of Commerce's National Institute of Standards and Technology has undertaken a number of initiatives in this space.[18] The Electron Physics Group in the Center for Nanoscale Science and Technology has collaborated with the Georgia Institute of Technology, Seoul National University, and the University of Texas – Austin to "support the development of graphene-based future electronics."[19]

In May of last year, Oak Ridge National Laboratory in Tennessee published findings demonstrating commercially viable methods of fabricating 2-inch-by-2-inch sheets of graphene.[20] Materials research funding also occurs through the National Science Foundation's Division of Materials Research in the Mathematical and Physical Sciences Directorate and includes topics such as biomaterials, ceramics, and electronic and photonic materials.[21]

IV. ISSUES

The following issues will be examined at the hearing:

- How have new materials, new fabrication processes, and new applications for such materials and processes impacted the U.S. economy? How have established industries adjusted to the introduction of new materials?

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[12] http://www.worldsteel.org/steelstory/
[13] http://www.aluminum.org/aluminum-advantage/history-aluminum
[14] Susan Freinkel, "A Brief Hisotry of Plastic's Conquest of the World" Scientific American, May 29, 2016, available at https://www.scientificamerican.com/article/a-brief-history-of-plastic-world-conquest/
[15] Ed Crooks "The US shale revolution" Financial Times, April 24, 2015, available at https://www.ft.com/content/2ded7416-e930-11e4-a71a-00144feab7de.
[16] https://www.americanchemistry.com/Media/PressReleasesTranscripts/ACC-news-releases/ACC-Releases-December-2016-Resin-Production-and-Sales-Statistics.html
[17] Leah Burrows, "Portable nanofiber device offers precise, point-and-shoot capability" Harvard John A. Paulson School of Engineering and Applied Sciences, March 1, 2017, available at http://www.seas.harvard.edu/news/2017/03/portable-nanofiber-device-offers-precise-point-and-shoot-capability.
[18] https://www.nist.gov/programs-projects/structure-defects-and-scattering-graphene
[19] *Id.*
[20] Ron Walli, "ORNL demonstrates first large-scale graphene composite fabrication" Oak Ridge National Laboratory, U.S. Department of Energy, May 14, 2015, available at https://www.ornl.gov/news/ornl-demonstrates-first-large-scale-graphene-composite-fabrication.
[21] https://www.nsf.gov/funding/programs.jsp?org=DMR

- What is the current state of investment in advanced materials? What factors affect investment into emerging materials technology in the U.S.?

- How is the development of additive manufacturing technologies affecting the deployment of commercial applications of new materials and compounds?

V. STAFF CONTACTS

If you have any questions regarding this hearing, please contact Paul Nagle or Melissa Froelich of the Committee Staff at (202) 225-2927.