Small Business Innovation Research
Small Business Technology Transfer
Encouraging Innovation in Manufacturing
Annual Report
FY 2015

America's Seed Fund Powered by the SBA

Small Business Administration

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Introduction

Section 9(ss) of the Small Business Act, 15 U.S.C. § 638(ss) requires that the annual report contain the following information about Executive Order (E.O.) 13329:

1) a description of efforts undertaken by the head of the Federal agency to enhance United States manufacturing activities;
2) a comprehensive description of the actions undertaken each year by the head of the Federal agency in carrying out the SBIR or STTR program of the agency in support of Executive Order 13329 [note to this section] (69 Fed. Reg. 9181; relating to encouraging innovation in manufacturing);
3) an assessment of the effectiveness of the actions described in paragraph (2) at enhancing the research and development of United States manufacturing technologies and processes;
4) a description of efforts by vendors selected to provide discretionary technical assistance under subsection (q)(1) to help SBIR and STTR concerns manufacture in the United States; and
5) recommendations that the program managers of the SBIR or STTR program of the agency consider appropriate for additional actions to increase the effectiveness of enhancing manufacturing activities.

Pursuant to E.O. 13329, Agencies must give priority to small business concerns that participate in or conduct R/R&D "…relating to manufacturing processes, equipment and systems; or manufacturing workforce skills and protection." Each Agency includes in its Annual Report to the SBA a synopsis of its implementation of these requirements. Agencies utilized a variety of approaches in addressing the E.O. 13329 directive. For most, these requirements are assessed within the scope of each Agency's R/R&D needs with tangible numbers of solicitation topics, awards, and dollars. Mechanisms commonly used by Agencies to give priority to manufacturing-related work include: adding manufacturing-related topics in solicitations; requesting in solicitations that proposals address any possible manufacturing-related elements of the small businesses' proposed work, technological approach, delivery or resulting technological applicability to manufacturing processes; and, noting in solicitations that including such elements in proposals may provide a competitive advantage in the award selection process. Additionally, cross-Agency collaborations, targeted outreach efforts, and other Agency-specific activities related to manufacturing contribute to addressing the objectives of E.O. 13329.

Department of Agriculture (USDA)

The USDA's FY2015 Annual Report states that there were 11 Phase I awards involving Manufacturing Topics, with $1,082,112 in corresponding Phase I obligations, and 10 Phase II awards involving Manufacturing Topics, with $ 4,938,321 in corresponding Phase II obligations. However, with respect to the agency's annual E.O. 13329 Report, the USDA states, "*The action plan listed below [in the USDA FY15 Annual Report] is out of date and is currently in the process of being updated in 2016. USDA SBIR will provide the new action plan in the next annual report*."

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Department of Commerce (DOC)

NIST identified advanced manufacturing as one of its priorities in the “NIST 3-Year Programmatic Plan FY 2015 – 2017”. NIST’s laboratories develop and supply test methods, measurement tools and know-how, and scientific data that are embedded in the processes, products, and services of the U.S. manufacturing industry. NIST has a number of programs that advance the state of the art in manufacturing including enabling technologies such as robotics, additive manufacturing, nano- and bio-manufacturing, precision measurements, and advanced materials development. NIST hosts the Advanced Manufacturing National Program Office and the Advanced Manufacturing Technology Consortia (AMTech) Program. NIST’s Hollings Manufacturing Extension Partnership (MEP) is a federal-state partnership that provides a network of technical assistance centers and offices located in every state. NIST also supports the National Network for Manufacturing Innovation (NNMI). NNMI institutes create, showcase, and deploy new capabilities and new manufacturing processes.

The NIST SBIR program supports manufacturing-related research projects through it solicitations and awards. In FY 2015, NIST’s annual SBIR solicitation contained 8 manufacturing-related research topics. More than 50 percent of NIST’s Phase I awards were related to manufacturing. The solicitation included a notice describing Executive Order (EO) 13329 and encouraged innovation in manufacturing by giving high priority, where feasible, to projects beneficial to the manufacturing sector. A Manufacturing-related R&D Emphasis in SBIR web page is available. The NIST SBIR Program Office provides proposer contact and project information to MEP as authorized by applicants.

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Department of Defense (DOD)

As innovation in manufacturing through small businesses is the key to improving the United States economy, President George W. Bush enacted Executive Order (EO) 13329 on February 26, 2004, to ensure that Federal agencies properly and effectively assist the private sector in its manufacturing innovation so as to sustain a strong manufacturing sector. EO guidelines state that all government agencies with one or more Small Business Innovation Research (SBIR) programs or one or more Small Business Technology Transfer (STTR) programs give high priority to manufacturing related research and development (R&D) processes, systems, and workforce protection. This includes manufacturing processes, equipment, and systems; or manufacturing workforce skills and protection. The DOD SBIR/STTR program has worked to integrate manufacturing related projects into their program since EO 13329 was signed. In the pages that follow please find a full report of the DOD's findings of the implementation of EO13329 across participating DOD components.

Manufacturing Related SBIR/STTR Awards FY15				
Agency	Phase I Dollar Amount	Phase I Award Count	Phase II Dollar Amount	Phase II Award Count
Air Force	$18,573,940	129	$61,224,411	85
Army	$5,386,824	47	$15,397,805	27
CBD	$0	0	$0	0
DARPA	$5,268,052	36	$29,792,266	25
DHP	$746,860	6	$4,935,756	5
DLA	$1,508,317	18	$979,527	1
DTRA	$897,802	6	$0	0
MDA	$7,251,936	61	$16,916,424	20
Navy	$11,742,269	158	$36,074,026	70
OSD	$0	0	$9,776,797	9
SOCOM	$3,107,385	21	$0	0
DOD TOTAL	**$54,482,385**	**482**	**$175,097,012**	**242**

Procedures/Mechanisms Used to Give Priority to Manufacturing-related SBIR Projects.

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DOD SBIR/STTR releases three solicitations per year; included in these solicitations are topics related to and promoting manufacturing technology. Some examples of promoting manufacturing related projects by participating DOD components are as follows:

a. The Air Force identifies manufacturing technology as a tie-breaker in solicitations, stating the Air Force will evaluate proposals in descending order of importance with technical merit being most important, followed by the Commercialization Plan, and then qualifications of the principal investigator (and team) and that, where technical evaluations are essentially equal in merit, and the cost and/or price is a substantial factor, then cost to the Government will be considered in determining the successful offeror. The next tie-breaker on essentially equal proposals will be the inclusion of manufacturing technology considerations.
b. The Army collaborates with the U.S. Army Manufacturing Technology (ManTech) Program to integrate and align SBIR efforts directly into ManTech projects. The ManTech Program Management Office (PMO) reviews, evaluates and endorses manufacturing-related topics for manufacturing-relatedness against the following five categories:
    1. Core Manufacturing Innovation Topic.
    2. Addresses manufacturing process, technique, or innovation.
    3. Addresses manufacturing development, application, and tools used in advanced processes.
    4. Targets manufacturing manufactures for related equipment, systems, or production lines.
    5. Addresses the affordability, and reproducibility of demonstrated technology.
        i. Of specific concern to the Chemical and Biological Defense Program is unit cost of technologies having the potential for distribution to individual Warfighters. Therefore, SBIR topics that address the affordability, producibility, or manufacturing of an innovative technology are of particular importance and given greater priority for inclusion into future SBIR solicitations. CBD SBIR topics are assigned to one of the following seven categories:
    1. Research for a process or product that has significant manufacturing implications, although not the sole purpose of the topic.
    2. Topic addresses the development or application of advanced technologies for manufacturing processes, tools, and equipment.
    3. Topic includes manufacturing issues associated with technology under development.
    4. Research Topic that has Product or System Focus, Addressing Manufacturing Aspects of that Product.

5. Primary objective of topic is to develop a system or weapon-specific capability.
6. Manufacturing, producibility, cost and yield are referenced but not the primary objective of the task.
7. Manufacturing-related activities may be part of Phase II.

c. DARPA leverages their Open Manufacturing program to solve this problem by building and demonstrating rapid qualification technologies that comprehensively capture, analyze and control variability in the manufacturing process to predict the properties of resulting products. Success could help unleash the potential time- and cost-saving benefits of advanced manufacturing methods for a broad range of defense and national security needs.

d. DLA seeks drastically lower unit costs of discrete-parts support through manufacturing revolutions that also have applicability to low and high volume production from commercial sales. This will result in an improvement in the affordability of these innovations to DLA and its customers and the development of cost effective methods to sustain existing defense systems while potentially impacting the next generation of defense systems.

Actions Taken Toward Promoting and Supporting Manufacturing-related Research Projects.

DoD continues to take an active approach to promoting and supporting manufacturing-related research projects. This is done through attending outreach event, collaborations with various organizations and offices such as ManTech, etc. Some examples of this promotion are:

a. The Army and Air Force SBIR/STTR programs publish and advertise success stories for outstanding manufacturing related projects. These websites bring together the small business communities, component researchers, Program of Record, prime contractors, and the ManTech community for possible collaboration on new and ongoing SBIR/STTR projects.

b. Transition assistance is offered by various DOD components in support of their manufacturing related projects. Army SBIR/STTR employs transition assistance to firms whose proposals have met and/or exceeded all Army SBIR criteria. Transition assistance is available through Phase II Commercialization Readiness Program (CRP). Similarly, the DARPA Small Business Programs Office has contracted with Strategic Analysis, Inc. Technology Transition and Commercialization team (T2C Team) to implement the Transition and Commercialization Support Program (TCSP). The T2C Team is providing high level review companies' transition and commercialization strategy, transition and commercialization strategy, transition and commercialization planning support,

identification and introduction to potential collaborators, potential partners and potential sources of Phase III funding, and identification of thought leadership opportunities.

c. Several components, including Army, OSD, DLA, work closely to incorporate the ManTech program during topic writing and Phase I and Phase II source selection processes.

d. DoD Components regularly participate in manufacturing related conferences including: Beyond Phase II, Defense Manufacturing Conference (DMC), and Nanotechnology for Defense (NT4D). During these conferences one-on-one discussions were conducted between SBIR program personnel and small business representatives to investigate application of their technologies to the mission and requirements of the DoD community.

e. Almost the entire DoD community promotes EO 13329 through posting various links to manufacturing related documents and websites including:
    1. The Department of Commerce (DOC) “Manufacturing in America” article.
    2. Establishing a link to EO13329 on their respective SBIR/STTR public website.

Examples of Manufacturing-related SBIR Projects.

A list of manufacturing-related projects can be found in Appendix A.

An Assessment of the Effectiveness of the Actions Taken at Enhancing the R&D of U.S. Manufacturing Technologies and Processes. The DoD is extremely interested in continuing to improve the effectiveness of the R&D of U.S. manufacturing technologies and processes. DoD SBIR/STTR programs are a few of the ways in which the R&D of U.S. manufacturing technologies and processes are successfully enhanced as it represents a direct investment in the development of this essential focus area. Through the advancement of grand ideas, innovative technologies and processes that would never before have been nurtured are discovered and developed, improving U.S. manufacturing’s standing throughout the world. Much of the DoD community conducts internal evaluation to assure topics are apportioned to manufacturing innovation. For example, MDA continues to experience success in soliciting manufacturing technology proposals. MDA’s primary focus has been on improved manufacturing of structural components of missiles, manufacturing of light-weight batteries, and manufacturing of focal plane array sensor systems. All developed products are manufactured in the U.S.

Description of Efforts Undertaken by Vendors Selected to Provide Discretionary Technical Assistance to Help SBIR/STTR Business Concerns Manufacture in the U.S. When applicable DoD components makes use of the additional $5,000 dollars allotted per year to SBIR awardees for discretionary technical assistance through

contractors with expertise in this area. This caveat can be found in the 2012 SBIR Policy Directive, Amendment III H. Section 9(c).

Recommendations from the Agency's SBIR and STTR Program Manager of Additional Actions to Increase Manufacturing Activities in the U.S. The DoD recommends utilizing resources available to increase manufacturing activities in the U.S and encouraging organizations to focus on topics that will highlight manufacturing. Closer collaboration regarding topics at the very beginning stages of topic development should kindle an increase in the successful transition of future projects to the commercial market. Further, coordinating activities with manufacturing technology programs already existing within the Services, such as U.S. Army ManTech program must continue. ManTech focuses on transitioning projects from Phase II to Phase III, the ultimate goal of the SBIR program. Some additional component recommendations are as follows:

a. CBD SBIR recommends OSD Office of Small Business Programs continue to facilitate a relationship between SBIR/STTR and the Defense Manufacturing Conference; this is a synergist outreach event that will improve manufacturing opportunities between small businesses and industrial partners.

b. DLA SBIR suggests streamlining the contracting process to increase timely investment in U.S. manufacturing. Long procurement times negatively impact the small business concern's ability to form and maintain commercialization partnerships necessary for manufacturing invests to be successful. Consolidating contracting activities that can focus on understanding SBIR contract awards will expedite manufacturing based awards.

c. MDA states that the key to increasing manufacturing activities in the U.S. is worker productivity. Productivity must exceed the high financial liability of labor overhead to be successful. If we are to contribute in this area, some portion of the research budget must be set aside for component design simplification and process automation. Each worker must be empowered to produce products more economically and at a faster rate. Further, simplified designs will enable faster and more reliable assembly techniques. Relevant systems must also rely on common components for common functions. This will increase the scale of production for individual parts and make manufacturing more economical.

d. Navy SBIR supports providing vendors with training on manufacturing risks and mitigation strategies.

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Department of Education (DoED)

The U.S. Department of Education (ED) operates its SBIR program at the Institute of Education Sciences (IES). The ED SBIR Program uses a contracts mechanism to provide up to $1,050,000 in funding ($150,000 for Phase I; $900,000 for Phase II) to small business firms and partners for the research and development (R&D) of commercially viable education technology products for use by students and teachers in education and in special education settings.

Broadly speaking, ED's SBIR program is designed to support and encourage R&D in manufacturing through "environment or societal, and systems level technologies" (as defined by SBA, 2005). These projects encompass a range of manufacturing topics, such as artificial intelligence, information technology devices, software, systems, devices, and product design.

In 2015, attention was paid in identifying projects that were manufacturing-related. Of the 21 contracts awarded, many are conducting R&D of software and hardware components, which if demonstrated to be a feasible could potentially be manufactured and commercialized on a broader scale during Phase III of the SBIR program.

Examples of ED SBIR Manufacturing-Related Projects:

With a 2015 Phase II award, Schell Games is developing Happy Atoms, a set of physical models paired with an iPad app to cover high school chemistry topics in atomic modeling. The modeling set (which is manufactured to bring the product to market) includes individual plastic balls representing the elements of the periodic table. Students use the iPad app to take a picture of models they create. Using computer-generated algorithms, the app then identifies the model and generates information about its physical and chemical properties and uses. The app also informs students if a model that is created does not exist. Happy Atoms replaces or supplement lesson plans to enhance chemistry teaching. The app includes teacher resources suggesting how to incorporate games and activities to reinforce lesson plans and learning. For more information, see:

http://ies.ed.gov/funding/grantsearch/details.asp?ID=1598

With a 2011 Fast-Track award, Diversified Construction Services developed the STEM Solar Explorations platform. This platform is a multidisciplinary solar energy field laboratory to supplement middle school standards. The hardware component (which is manufactured to bring the product to market) includes physical solar equipment to capture real-time data to be wirelessly transmitted to classrooms. The web-based component hosts the STEM curriculum focusing on energy concepts, a dashboard to present data, and materials to facilitate teacher In FY2015, ED SBIR implemented the following procedures to give priority to manufacturing related projects:

1) Placed a notice in FY2015 SBIR program solicitations that details Executive Order 13329;

2) Placed a forced-choice question in the 2015 SBIR program solicitations for applicants to indicate (yes or no) whether their proposed project is “manufacturing-related;”

3) Placed language in the solicitation advising potential applicants that ED SBIR offices will give priority to manufacturing-related projects in the event of a tie in the award selection process. (Note: This “tie-breaker” specification allows the ED SBIR program to apply an additional preference without compromising the quality standards or established criteria of the program).

In FY2015, ED SBIR used the following procedures and mechanisms to promote and support Executive Order 13329:

1) Maintained the notice on the ED SBIR website that describes Executive Order 13329, provides a definition of manufacturing-related projects in education, and provides a web-link to the Executive Order;

2) Continued tracking and reporting success stories demonstrating the impact of the SBIR program on manufacturing;

3) Placed a notice in FY2015 SBIR program solicitations on manufacturing;

4) ED SBIR will continue to discuss how to best implement Executive Order 13329 related to manufacturing. training and implementation. The platform allows students to apply knowledge to daily changes in the position of the sun and to solar energy production, and to conduct hands-on investigations to address curricular content. For more information see here: http://ies.ed.gov/funding/grantsearch/details.asp?ID=1216

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Department of Energy (DOE)

The Advanced Manufacturing Office within the Office of Energy Efficiency and Renewable Energy (EERE) leads manufacturing innovation for the Department of Energy (DOE).

Enhancement of United States Manufacturing Activities by the Department of Energy

Manufacturing is critical to future U.S. innovation, global economic competitiveness, and job growth, particularly the manufacture of clean energy products. Manufacturing is the use of energy, equipment, information, services, and capital to convert raw materials, components, and parts into goods that meet market expectations. As an economic sector, manufacturing generates 12 percent of U.S. Gross Domestic Product (GDP)[1] and employs 12 million Americans[2]. While being a key sector underlying long-term economic growth, manufacturing also has an annual energy bill of about $200 billion and uses roughly one-third of the primary energy (and related GHG emission) in the U.S[3]. With opportunities to improve energy efficiency in specific manufacturing processes by 25 percent or more, the development and deployment of manufacturing technologies has multiple benefits in reducing both the energy footprint and associated GHG emissions from manufacturing as well as supporting the competitiveness in the manufacturing of new clean energy products. U.S. manufacturing can particularly benefit from technologies for energy efficiency across the board, as industry must continually improve productivity and efficiency to remain globally competitive.

There is also a large opportunity to improve the cost effective manufacture of products that reduce energy consumption in their distribution, use, and disposal. New or improved materials, technologies, and processes can drive forward the U.S. manufacturing of products at globally competitive costs while achieving significant energy, carbon and economic benefit across the economy—ensuring that technologies invented in the US ultimately result in the manufacture of high-quality clean energy products in the U.S.

[1] "GDP by Industry / VA, GO, II, EMP," 2013, Bureau of Economic Analysis; available from: http://www.bea.gov/industry/xls/GDPbyInd_VA_NAICS_1997-2013.xlsx
[2] "GDP by Industry / VA, GO, II, EMP," 2013, Bureau of Economic Analysis; available from: http://www.bea.gov/industry/xls/GDPbyInd_VA_NAICS_1997-2013.xlsx
[3] Annual Energy Outlook 2014: Reference Case Data, U.S. Energy Information Administration, available from: *http://www.eia.gov/forecasts/aeo/data.cfm*

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The Program's research, development, demonstration, and deployment (RDD&D) investments bring together manufacturers, research institutions, suppliers, and universities to advance high-impact technologies for energy efficiency in the manufacturing sector in addition to foundational, cross-cutting manufacturing and materials technologies critical to efficient and competitive domestic manufacturing of clean energy products. The Program addresses these clean energy manufacturing challenges using three primary modalities of support: research and development of early stage manufacturing technologies through the support of individual R&D projects, pre-commercial technology development through facilities and manufacturing consortia, and technology assistance through manufacturing partnership participation, assessment and evaluation tools. These modalities are represented by the three sub-programs: Advanced Manufacturing R&D Projects, Advanced Manufacturing R&D Facilities, and Industrial Technical Assistance.

Advanced Manufacturing R&D Projects: Through competitively-selected R&D investments in foundational energy-related advanced manufacturing technologies, the Program will increase the impact of its work in thrust areas relevant to energy-intensive and energy-dependent industries as well as materials and technologies widely applicable across multiple clean energy manufacturing industries. The Advanced Manufacturing R&D Projects subprogram will support innovative manufacturing projects at American companies and research organizations that focus on specific high-impact manufacturing technology and process challenges in order to increase energy productivity. These projects will fund the development of next generation production technologies. Development will also take into account down-stream challenges to better facilitate the ultimate transition of these technologies into domestic industrial production facilities. The High Performance Computing for Manufacturing (HPC4Mfg) program funds national laboratories to help U.S. industry tackle some of their most challenging problems by partnering world-class Nationals Lab experts with corporate researchers to model their technologies on some of the world's fastest supercomputers.

Advanced Manufacturing R&D Facilities: The Advanced Manufacturing R&D Facilities subprogram supports public-private R&D partnership facilities and consortia for clean energy manufacturing technology research and development. Through these facilities, the subprogram also helps facilitate the transition of innovative next generation material processes and production technologies to industry. The Program's facilities include Clean Energy Manufacturing Innovation Institutes, the Critical Materials Hub, and the Manufacturing Demonstration Facility, and are designed to accelerate the development and implementation of cutting edge energy efficiency technologies applicable to energy-intensive and energy-dependent industries and materials and technologies broadly applicable to the manufacturing of clean energy products. The benefits from these Clean Energy Manufacturing Innovation Institutes and other advanced manufacturing R&D facilities will be spread broadly across multiple industries and improve U.S. competitive advantage, especially for small- and medium-sized

enterprises (SMEs). Further, the investments with universities and SMEs contribute to developing national capabilities that enable future global leadership.

Industrial Technical Assistance: The Industrial Technical Assistance subprogram is implemented through the Combined Heat and Power (CHP) deployment activities including CHP Technical Assistance Partnerships (TAPs), formerly known as Clean Energy Application Centers (CEACs); the Better Buildings Better Plants program; Industrial Assessment Centers (IACs); and the Superior Energy Performance (SEP) International Organization for Standardization (ISO)/American National Standards Institute (ANSI) Certification. Through these activities, the Industrial Technical Assistance subprogram's goals are to assist in the deployment of 40 gigawatts (GW) of new, cost-effective CHP by 2020, demonstrate the technical and economic viability of improved energy management approaches, and support a reduction in manufacturing energy intensity by 25 percent over ten years.

Work in these three sub-programs focuses on manufacturing issues in two categories: (1) energy cost reduction and efficiency for the Nation's most energy-intensive and energy-dependent industries and (2) materials and enabling technologies with cross-cutting impact for cost reduction and performance improvement broadly applicable to the manufacturing of clean energy products. The Program identifies topical thrusts within each of these two categories and uses them as organizing priorities for existing and proposed technical work. These thrusts are identified through extensive consultation with private sector firms, non-profit, university and National Laboratory partners, as well as coordination across the department through the clean energy manufacturing activities to ensure high potential for impact to multiple technology offices, and are selected on the basis of potential energy, environmental, and economic impacts.

FY 2015 Department of Energy SBIR/STTR Activities in Support of Executive Order 13329

The Advanced Manufacturing Office sought materials and enabling technologies relating to wide bandgap semiconductors, natural gas feedstock and fuel substitution, carbon fiber production, and novel low cost recovery from low temperature waste heat. The following subtopics were included in the FY 2015 DOE SBIR/STTR Phase I Release 2 Funding Opportunity Announcement and resulted in fourteen Phase I awards.

- **Wide Bandgap Semiconductors for Energy Efficiency and Renewable Energy**

  Wide bandgap (WBG) semiconductor-based devices — with bandgaps significantly greater than 1.7 eV — operate at much higher voltages, frequencies, and temperature than conventional semiconductor-based devices. DOE has made significant R&D investments in WBG semiconductors. WBGs-- including silicon carbide (SiC), gallium nitride (GaN), zinc oxide (ZnO), aluminum nitride (AlN) and diamond (C) offer dramatic

improvements in a variety of applications such as power electronics, solid state lighting, fuel cells, photovoltaics, and sensing in harsh environments.

Compared to today's Si-based technologies, devices using WBGs can operate at higher temperatures, operate at greater voltages over time, and switch at much higher frequencies than those based on non-WBG substrates. Depending on current density, power dissipation, and reverse breakdown voltage requirements, semiconductor devices are structured as either vertical or lateral structures. While vertical SiC and lateral GaN/(SiC, Si, Sapphire)-based semiconductor devices are commercial, vertical GaN devices (LEDs and power devices) built on GaN substrates and vertical AlN or AlGaN devices (UV-C LEDs and power devices) built on AlN substrates are not. Making commercial vertical LEDs on GaN and AlN or AlGaN substrates would have major power and efficiency advantages including: greater brightness (2-3x); higher current tolerance; and smaller and less expensive chips due to improved geometry compared with LEDs on other substrates such as Sapphire. To develop these applications, the substrates must be conducting, and LED substrates also must be transparent. These properties are controlled by point defects in the substrates, so identifying and eliminating these point defects is a key research goal.

Research areas below are important for the fabrication of conducting and transparent(e.g. LED) substrates; for improved doping control during boule and epi-growths; and for increasing scientific understanding of relatively deep donor and acceptor levels, ion-implantation, and subsequent activation of donor and acceptor impurities.

Areas of particular interests include:

Substrate Forming from Bulk GaN Crystals: While much R&D has been conducted on the methods for growing low defect, low-optical-absorption bulk GaN crystals, significant advances are still required to make epi-ready substrates. GaN has similar mechanical properties to SiC, and many mechanical forming methods such as slicing, grinding, and mechanical polishing can be adapted from SiC. As each step in the epi-ready substrate formation process is highly dependent on the preceding step, it is important to adapt these operations in a concurrent, balanced manner.

Mechanical shaping steps must be cost effective and minimize subsurface damage; achieve reasonable wafer shape (as measured by bow, warp, and total thickness variation and local thickness variation); and consider requirements for scaling diameter and volume. After mechanical polishing, final surface preparation with chemo-mechanical polishing (CMP) steps are required to remove surface and subsurface damage and present a high quality surface to grow low-defect epitaxial films. Developing a commercially viable CMP process with a reasonable removal rate requires a thorough study of chemistries and mechanical (down)

forces with careful control of all interacting parameters such as chemistry, temperature, down-force, linear abrasion speed, viscosity, slurry flow rates and concentrations. The difficulty with CMP on relatively hard crystals such as GaN and SiC is in achieving a viable removal rate while balancing all process parameters to create a smooth surface. Removal rates can also be heavily influenced by crystallographic orientation, defect density, defect size, defect type, and doping / impurity type and concentration. The final steps required include non-destructive surface characterization techniques that can be performed with high speed and accuracy at low cost. Of particular interest is the ability to measure sub-surface damage, which is currently impossible using optical microscopy.

Doping Control and Producing Shallow Donors in AlN Substrates and Epilayers: Improving control of dopant incorporation and production of shallow donors is critical during boule and epi growth. Applications are sought that show a path to the controlled incorporation of shallow donors (10 µm) epilayers grown on AlN or other suitable WBG substrates. AlN substrates with thick epilayers and n-type (vertical) conduction are needed for a wider array of devices including both LEDs and power devices. While AlN-based LEDs producing light at between 200-300 nm are already being commercialized for water purification, it is still difficult to obtain n-type conduction for AlN substrates and epilayers [7, 8, 9, and 10]. An understanding of the doping mechanism and of controlled and reproducible doping in AlN is needed to manufacture these vertical structures. A Si concentration of 3x1019 cm- 3 is the upper doping limit for achieving n-type conductive Si-doped AlN. At that limit, the highest electron concentration of 9.5x1016 cm- 3 has been obtained.

• **Natural Gas Feedstock and Fuel Substitution for Energy Efficient Manufacturing**

The recent emergence of new supplies of natural gas in the United States, along with the use of more energy efficient technologies, has the potential to increase competitiveness in American manufacturing. Point-of-use, on-demand production systems in miniaturized chemical processing systems could offer improved environmental and safety benefits [3]. The realization of these benefits depends on the availability of low cost, modular process technologies that overcome low economy of scale issues and mitigate demonstration risks. Plasma reforming of natural gas offers the opportunity for process intensification. Applications are sought to develop novel thermal and non-equilibrium (also called cold plasma) reactors for manufacturing valuable products from natural gas. Selective conversion is sought to produce useful products such as acetylene, carbon black, or high performance carbon materials. As this subtopic focuses on reactor development, proposals should clearly demonstrate existing pathways to integration of any necessary catalysts. Novel processes must show improvements to yield, selectivity, and economics compared to state-of-the art technology.

• **Carbon Fiber Production Processes**

Due to their high strength-to-weight ratio, stiffness, and outstanding corrosion resistance properties, carbon fiber composites can be used to lightweight: vehicles, next generation blades for wind and other turbine technologies, and high pressure storage tanks for natural gas and hydrogen. Several challenges remain for carbon fiber composites to achieve widespread adoption. Current carbon fiber technology relies primarily on polyacrylonitrile (PAN) precursors, a polymer of acrylonitrile (ACN). ACN in turn is made from petroleum (propylene) and natural gas (ammonia) feedstocks. The precursor PAN-based material is subject to convection heating in an oxidation oven and subsequent high-temperature carbonization. These processes are energy-intensive and generate high levels of off-gases that must be treated before being released. To reduce these problems, EERE has supported potentially lower-energy methods of converting precursor material to the final fiber form such as the development of atmospheric plasma technologies and microwave assisted plasma-based technologies.

Areas of particular interest include:

Low Energy Conversion of Polyacrylonitrile to Carbon Fiber: EERE is seeking innovative and novel processes that are less energy- and carbon- intensive compared to the standard oxidation and carbonization steps used to convert PAN-based precursors to carbon fiber. The deliverable for this area should demonstrate a minimum of 25% reduction in energy intensity over fiber production in current commercial practice. The deliverable must show, through the synthesis of carbon fiber, with sufficient experimental measurements and supporting calculations, that cost-competitive energy savings can be achieved with practical economies of scale. Applications should provide a path to scale up in potential Phase II follow on work. Applications involving the use of atmospheric plasma or microwave assisted plasma technologies are outside the scope of this topic area.

Novel Catalytic Routes to Direct Synthesis of Carbon Fiber from Gas or Solution Phase: Advances in the design and synthesis of solid atomically-precise enzyme-like catalytic structures offer the potential for direct conversion of low-cost chemicals to solid products. AMO seeks to advance solid catalyst technology for the production of carbon fiber from low cost chemicals in a commercially competitive and scalable processing approach. The subtopic deliverable should demonstrate a minimum of 25% reduction in energy intensity over fiber production in current commercial practice. The deliverable must show, through the physics-based design and synthesis of atomically precise solid catalysts, (with sufficient experimental measurements and supporting calculations), that the technology could feasibly synthesize carbon fiber. It also must show that cost-competitive energy savings can be achieved with practical economies of scale. Applications should provide a path to demonstration of carbon fiber synthesis (if not actual synthesis), and to process scale up in potential Phase II follow on work.

• **Novel Low Cost Recovery from Low Temperature Industrial Waste Heat**

The industrial sector accounts for about 31 Quads [1] of energy consumption, more than any other sector in the American economy. An estimated 20-50% [2] of this energy consumption is lost as waste heat. While some of this waste heat is at high temperatures, and is easily recovered using conventional recovery technologies, a substantial portion - as much as 60% [3] - is at temperatures below 450ºF, often in highly diffuse form. While thermo-electric (TE) technologies can be used to convert this heat directly into electricity, their low efficiencies (3$/watt) make them unattractive options. Advances in nanotechnology and nanofabrication have enabled new direct conversion (heat to electricity) technologies that have the potential to surpass the performance of TE systems. Some illustrative examples include plasmonics [4], thermionic emission [5], and vibration energy harvesting [6].

Applications are sought for novel low-cost approaches to direct energy conversion for low temperature (<450ºF) industrial waste heat streams that could significantly improve the energy efficiency of the industrial sector. Responses outside of the examples above are welcome, as they are for illustrative purposes only. Performance targets include a conversion efficiency between 20% and 30% (Electricity output measured as a fraction of thermal energy input) with a manufacturing cost <$1/W. The proposed technology must have adequate robustness for utilization in challenging industrial operations. Applications must show a credible path from early stage development through potential Phase II follow on work, to ultimate commercialization.

Contribution of Department of Energy SBIR/STTR Awardees to Enhancement of Unites States Manufacturing

SBIR has been a key component of the Advanced Manufacturing Office. The awardees with their energy technologies and practices supported by the AMO program have saved Americans several million dollars in energy costs over the past two decades. These savings are projected to dramatically increase as emerging and new energy technologies are developed and commercialized. These energy savings are accompanied by parallel reductions in emissions of pollutants that affect human health and in the production of greenhouse gases.

SBIR/STTR Technical Assistance to Promote United States Manufacturing

To promote domestic manufacturing the Department of Energy directs applicants to utilize the Manufacturing Extension Program (MEP) of the National Institute of Standards and Technology. The following paragraph is incorporated into our SBIR and STTR Funding Opportunity Announcements:

> Technical Assistance for Proposal Preparation and Project Conduct – SBCs may wish to contact their local National Institute of Standards and Technology (NIST) Hollings Manufacturing Extension Partnership (MEP) for manufacturing and other business-related support services. The MEP works with

small and mid-sized companies to help them create and retain jobs, increase profits, and save time and money. The nationwide network provides a variety of services, from business development assistance to innovation strategies to process improvements and the identification of commercialization opportunities. MEP is a nationwide network of locally managed extension centers with over 1,400 technical experts – located in every state. To contact an MEP center, call 1-800-MEP-4-MFG (1-800-637-4634) or visit MEP's website at www.mep.nist.gov.

The technical assistance program operated by the Department of Energy to provide commercialization assistance to SBIR/STTR awardees is currently operated by Dawnbreaker. Although Dawnbreaker provides a number of services (e.g. commercialization planning, competitor analysis) that indirectly provide support and justification for those who wish to manufacture, their services are not intended to duplicate the nationwide network of manufacturing expertise offered by MEP. Because of the flexibility offered to SBIR/STTR awardees in choosing their technical assistance provider, applicants can opt not to use the services offered by Dawnbreaker, and instead propose to use available technical assistance funding ($5000 in Phase I; $5000/year in Phase II) towards other organizations such as MEP.

Increasing the Effectiveness of Enhancing Manufacturing Activities

The AMO collaborative R&D facilities provide opportunities for small businesses to leverage novel domestic manufacturing capabilities. R&D Facilities include Demonstration Facilities, Energy Innovation Hubs and facilities that are part of the National Network for Manufacturing Innovation (NNMI). There will be an opportunity for Federal SBIR/STTR programs to utilize supplemental or sequential Phase II awards to help build relationships between small business concerns receiving SBIR/STTR awards and the collaborative R&D facilities to promote domestic manufacturing.

Manufacturing Demonstration Facility

Work conducted by MDF partners and users provides real data that is used to reduce the technical risk associated with full commercialization of promising foundational manufacturing process and materials innovations. The MDF, focused on Additive Manufacturing and Low-cost Carbon Fiber and located at Oak Ridge National Laboratory, is organized to foster an open exchange of pre-competitive manufacturing best-practices and know-how—including design and processing tools, qualification and certification approaches, and fabrication costing methods—while still protecting a company's proprietary intellectual property. MDF staff include designers, manufacturing experts, and product evaluators to guide and train users. The MDF may also host interns and guest workers from industry, academia, and government.

Critical Materials Hub

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The Critical Materials Institute (CMI), an Energy Innovation Hub led by Ames National Laboratory and a team of research partners, is a sustained, multidisciplinary effort to develop solutions across the critical materials lifecycle as well as reduce the impact of supply chain disruptions and price fluctuations associated with these valuable resources. Critical materials, including some rare earth elements that possess unique magnetic, catalytic, and luminescent properties, are key resources needed to manufacture products for the clean energy economy. By bringing together scientists and engineers from diverse disciplines, the CMI will address challenges in critical materials, including mineral processing, manufacture, substitution, efficient use, and end-of-life recycling; integrate scientific research, engineering innovation, manufacturing and process improvements; and find a holistic solution to the materials challenges facing the nation.

America Makes

America Makes, the National Additive Manufacturing Innovation Institute, advances additive manufacturing technology and products, and serves as a nationally recognized additive manufacturing center of innovation excellence, working to transform the U.S. manufacturing sector and yield significant advancements throughout industry. America Makes is focused on helping the United States grow capabilities and strength in additive manufacturing, also known as 3D printing, by facilitating collaboration among leaders from business, academia, non-profit organizations and government agencies. Focusing on areas that include design, materials, technology, workforce and more, America Makes helps the nation’s 3D printing industry become more globally competitive.

Power America

This Innovation Institute will concentrate on issues related to manufacturing wide bandgap power electronics. Power America, formerly called the Next Generation Power Electronics National Manufacturing Innovation Institute, will create, showcase, and deploy new power electronic capabilities, products, and processes that can impact commercial production, build workforce skills, enhance manufacturing capabilities, and foster long-term economic growth in the region and across the nation.

Power electronics convert and control electrical power across the grid and in a growing array of products used by industry, consumers, the military, and utilities. Wide bandgap (WBG) semiconductors—the same materials used in LED light fixtures and many flat screen TVs—can improve energy efficiency in the next generation of power electronics while also reducing cost and system size. WBG semiconductors used in variable frequency drives (VFDs), for example, increase the efficiency of industrial motor systems and expand the range of motor applications in which these energy-efficient drives are cost-effective. Moreover, WBG-based power electronics are more compact and reliable—even as they function at higher power loads, operating temperatures, and frequencies than today's widely used, silicon-based power electronics.

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Institute for Advanced Composites Manufacturing Innovation

Led by the University of Tennessee and headquartered in Knoxville, the **Institute for Advanced Composites Manufacturing Innovation** will work to develop new low-cost, high-speed, and efficient manufacturing and recycling process technologies that will promote widespread use of advanced fiber-reinforced polymer composites. At the new Institute, a team of organizations from leading industrial manufacturers, material suppliers, software developers, government and academia will focus on lowering the overall manufacturing costs of advanced composites by 50 percent, reducing the energy used to make composites by 75 percent, and increasing the ability to recycle composites by more than 95 percent within the next decade.

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Department of Homeland Security (DHS)

The joint DHS FY2015 SBIR solicitation encouraged innovation in manufacturing-related research and development through applicable topics which sought advanced processing, manufacturing processes, equipment and systems, or manufacturing workforce skills and protection. In FY2015, 120 proposals were received in response to the joint DHS SBIR Phase I solicitation. Of these, 26 offerors submitted 27 proposals that were self-identified as being manufacturing related. These 27 proposals were submitted in the following S&T Directorate topic areas: Low-cost, Disposable, Tamper-Proof Bolt Seal; Privacy Protecting Analytics for the Internet of Things; A Wearable Communications Hub Designed to Streamline and Improve First Responder Communication Capabilities; Total Vehicle Mobile X-Ray Scanner; and Canine Mounted Track and Transmit Device; and the following DNDO topic area: Stable Semiconductor Modules as Core Components in Pager Radiation Detectors.

S&T Directorate SBIR Program:

Of the 16 Phase I proposals submitted to the S&T Directorate's FY2015 SBIR topic areas that self-certified that the efforts were manufacturing related, three contracts were awarded. The contracts were awarded in the following two topic areas: Low-cost, Disposable, Tamper-Proof Bolt Seal; and Canine Mounted Track and Transmit Device. For the Low-cost, Disposable, Tamper-Proof Bolt Seal topic area, one Phase I contract was awarded to Evigia Systems, Inc. (Ann Arbor, MI) for their proposal entitled "Tamper-proof Electronic Bolt-Seal"; and one Phase I contract was awarded to Hi-G-Tek, Inc. (Rockville, MD) for their proposal entitled "Disposable Electronic Bolt Seal". For the Canine Mounted Track and Transmit Device topic area, one Phase I contract was awarded to MNW Tech (San Diego, CA) for their proposal entitled "CanineTRAKR: Tracking Recorder Advanced K9 Radio".

DNDO SBIR Program:

Of the 11 Phase I proposals submitted to DNDO's FY2015 SBIR topic area that self-certified that the efforts were manufacturing related, four Phase I contracts were awarded in the Stable Semiconductor Modules as Core Components in Pager Radiation Detectors topic area as follows: Lithium Innovations Company, LLC (Toledo, OH) for their proposal entitled "Personal Neutron Detector Based on Cadmium Telluride"; Agiltron, Inc. (Woburn, MA) for their proposal entitled "Compact Boron-Filled 3D Semiconductor Neutron Detector Module"; CapeSym, Inc. (Natick, MA) for their proposal entitled "Stable Tl-based Semiconductor Modules for Radiation Detection"; and Solid State Detection Devices, LLC (Watervliet, NY) for their proposal entitled "Next Generation Scalable Solid State Thermal Neutron Detector".

Department of Transportation (DOT)

FY 2015 Outreach: The U.S. DOT SBIR Program Director discussed manufacturing topics during briefings and one-on-one meetings conducted at the National SBIR conferences. The SBIR Program Office also informs prospective DOT awardees of the assistance available through NIST's Manufacturing Extension Partnership (MEP) Program and the USA National Innovation Marketplace.

FY 2015 Award Selection: In FY 2015, DOT awarded 11 manufacturing-related SBIR Phase I contracts and 2 manufacturing-related Phase II contracts. The Phase I awards were made for the topics Roadway Hazard Alert System for Motorcycles, Wireless Compatible Digital Train Line for Passenger Type Vehicles in a Train Consist, Active Personal Safety System for Train Yard and Road Crewworkers, Next Generation Freight Truck for Autorack Cars, Locomotive Flashing Light for Trespassers and Pedestrian Warning, Long Range ROW Detection and Warning System, Improving the Ventilation of Motorcycle Helmets, Modular Building Block Approach to Construction Assembly in Place Mini-Roundabouts and Device to Address the Competing Needs of Ensuring Lockability of Seatbelts and Mitigating Entrapment Risk in Mis-Use Conditions. Lightweight, Portable System for Mid-Chord Offset Measurements of Railroad Rails.

The Phase II awards were made for the topics SmartWorkZone - Situational awareness messages in the vehicle when driving through a work zone area, Tracking of heavy vehicles for estimating heavy load distribution across the highway system and Weigh-In-Motion Calibration, Pedestrian Auto Enforcement Program and Transit Safety.

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Environmental Protection Agency (EPA)

Manufacturing-related research and development (R&D) encompasses improvements in existing methods or processes, or wholly new processes, machines or systems. Manufacturing innovation is fostered by research and development of technologies that are aimed at increasing the competitive capability of manufacturing concerns. Four main areas include: (1) Unit process level technologies that create or improve manufacturing processes; (2) Machine level technologies that create or improve manufacturing equipment; (3) Systems level technologies for innovation in the manufacturing enterprise; and (4) Environment or societal level technologies that improve workforce abilities and manufacturing competitiveness.

This report covers: (1) Examples of Manufacturing-related SBIR Projects; (2) Procedures and Mechanisms Used to Give Priority to Manufacturing-related SBIR Projects; and (3) Outreach to promote Executive Order awareness.

Examples of Manufacturing-related SBIR Projects.

In FY 2015, EPA awarded 19 new SBIR Phase I projects and 8 new Phase II projects. Six Phase I awards and one Phase II award are manufacturing-related awards under E.O. 13329. These awards are for unit process level technologies that create or improve manufacturing processes, machine level technologies that create or improve manufacturing equipment, systems level technologies for innovation in the manufacturing enterprise or environmental or societal level technologies that improve workforce abilities and manufacturing competitiveness. The FY 2015 Phase I awards related to innovation in manufacturing were:

Firm Name	Project Title	Phase
Advanced Recovery and Recycling, LLC	Circuit Board Component Recovery for Electronic Waste Reduction	I
Industrial Microbes, Inc.	Low-Cost Biological Solution for Reducing Carbon Pollution in Chemical Manufacturing	I
SioTeX Corporation	Industrial Process Pollution Reduction by Development of Amorphous Biogenic Silica to Replace Fumed Silica	I
Faraday Technology Inc.	Hard Gold Plating for Electronics Applications from a Non-Cyanide Bath	I
TIAX LLC	Non-fluorinated Omniphobic Coatings for Stain resistant Textiles	I
TDA Research, Inc.	Icosyanate-Free Polyurethane Coatings	I

Mesocoat, Inc.	Development of Zinc Coatings on Steel by Cermaclad™ to Replace Galvanizing Pickling Lines	II

Procedures/Mechanisms Used to Give Priority to Manufacturing-related SBIR Projects.

The EPA SBIR Program continues to make manufacturing a priority in its annual solicitations. Manufacturing is very important to the EPA's mission of protecting human health and the environment as it can impact many areas that have large environmental impact including water and energy use, toxicity, pollution, waste disposal, etc. The EPA considers all of these impacts when evaluating proposals for selection.

SBIR program solicitation includes a "Manufacturing" topic shown below:

Manufacturing

Executive Order 13329 directs the EPA to properly and effectively assist the private sector in its manufacturing innovation in order to sustain a strong manufacturing sector in the U.S. economy. These innovations often involve engineering and technical solutions that make the manufacturing operation and/or the manufactured product both more environmentally and economically sound.

As a result, the EPA is seeking the development and commercialization of innovative technologies that, when compared with current technologies, dramatically improve the performance, dramatically reduces the environmental impacts, and significantly reduce the costs of both the production processes and the product characteristics of:

a. **Non-toxic electronics:** Next generation non-toxic electronic devices and components.

Other solicitation topics also cover manufacturing-related needs including the air subtopic which focused on industrial process pollution reduction, and the building materials subtopic which focused on innovative construction materials.

Outreach to promote Executive Order awareness

EPA's SBIR Program has emphasized manufacturing-related topics and priorities at National, regional and state SBIR conferences and webinars. Emphasis has been placed on opportunities for businesses to submit new critical manufacturing technologies that improve both the process efficiency and the environmental impact of the technology. Many of EPA's success stories have been in the area of manufacturing (including multiple Tibbetts

awards) and EPA frequently publishes these success stories and other communications pieces on its SBIR website, www.epa.gov/sbir.

Department of Health and Human Services (HHS)

Examples of Manufacturing-related SBIR Projects.

Following are examples of projects funded in FY2015 that illustrate the beneficial impact that the HHS SBIR/STTR programs have on U.S. manufacturing:

Firm Name	Project Title
Actuated Medical, Inc.	BleedClear System: Rapid and Safe Removal of Coagulated Blood, Uncleared Fundal Pools, and Adherent Clots from the Stomach Through a 2.8 MM Endoscope Channel to Improve Efficacy in UGI Bleed Treatment
Lynntech, Inc.	Wearable Device to Monitor Blood Alcohol Levels in Real Time
Audiodontics, LLC	System for Monitoring Dental Device Compliance and Efficacy in Treatment of Obstructive Sleep Apnea

Actuated Medical, Inc.
310 Rolling Ridge Drive
Bellefonte, PA 16823

Contact: Maureen L. Mulvihill, Ph.D.
Phone: 1 (814) 355-0003
Web Site: http://www.actuatedmedical.com/

Project Title: BleedClear System: Rapid and Safe Removal of Coagulated Blood, Uncleared Fundal Pools, and Adherent Clots from the Stomach Through a 2.8 MM Endoscope Channel to Improve Efficacy in UGI Bleed Treatment

Related Award: 1 R43 DK107381-01

Technology Developed: Actuated Medical was formed in 2006 with a mission to use motion technologies to improve medical devices. In the intervening years, the company's innovations have spawned an entirely new generation of instruments and devices. Today, the company focuses on state–of–the art, minimally invasive

instruments for clearing occlusions, penetrating bone and tissue, and enabling the emerging MRI–guided surgical procedure industry.

Public Health Relevance: Inpatient care for acute gastrointestinal (GI) bleeding costs the healthcare industry $2.5 billion per year. Upper GI bleeds results in 250,000 to 300,000 hospitalizations and 15,000 to 30,000 deaths per year in the US annually. GI bleeds are generally treated with minimally invasive surgery using tools deployed through an endoscope. Masses of clotted blood in the stomach can increase complication rates by 43% due to lack of options to clear clots from the field of view with current devices. An accessory device for standard endoscopes is needed that can be deployed through the 2.8 mm working channel to quickly remove large clotted blood masses without having to remove or reposition the scope.

Abstract: This Phase I SBIR develops and tests feasibility of the BleedClear system to quickly clear coagulated blood that prevents effective visualization and treatment of upper gastrointestinal (UGI) bleeds. BleedClear is deployed through the 2.8 mm working channel of an endoscope, allowing the clinician to keep the endoscope in place while safely and quickly removing blood masses from the viewing area. Public Health Problem: Inpatient care for acute gastrointestinal (GI) bleeding costs the healthcare industry $2.5 billion per year. Upper GI bleeds alone result in 250,000 to 300,000 hospitalizations and 15,000 to 30,000 deaths per year in the US. UGI bleeds are generally treated with minimally invasive surgery using tools deployed through an endoscope. A well-known problem clinician's face is the presence of blood and clots that reduce endoscopic visibility and limit diagnosis and treatment of the bleeding site. Patients with uncleared fundal pools of blood, coagulated blood masses, or adherent clots suffer an increased risk of morbidity and mortality. Due to the size and quantity of the clots - often centimeters in scale - they typically clog the endoscope during attempts to aspirate them, requiring the scope to be pulled out and re-inserted multiple times in the course of a procedure. Tools employing improved suction and irrigation or graspers exist, but can still take hours of manipulation to clear clots. When visibility limits endoscopic diagnosis/treatment, I can impact length of stay, number of units of blood transfused, and lead to repeat endoscopy, interventional radiology procedures, or emergent surgery and thus straining hospital resources and driving up treatment costs. An accessory device for standard endoscopes is needed that can be deployed through the 2.8 mm working channel to quickly remove large clotted blood masses without having to remove or reposition the scope. Phase I Hypothesis: BleedClear Alpha II prototype quickly clears 3cm (diameter) x 6cm blood clots while deployed in 2.8mm working channel in UGI model, demonstrating basic feasibility of BleedClear for large clot clearance during diagnostic endoscopy for UGI bleed. Specific Aims: Aim 1: Develop BleedClear Alpha II handheld prototype and demonstrate clearing functionality while deployed in 2.8mm working channel in UGI model. Acceptance Criteria: BleedClear is successful in clearing clots when deployed through endoscope held in typical curvatures in anatomic UGI model. Feedback from clinicians (Gastroenterologists) supports overall feasibility and provide guidance to focus further development. Aim 2: Determine operating parameters for best

device performance for ranging clot firmness. Acceptance Criteria: BleedClear with operating parameters demonstrating ability to completely clear porcine blood clots (6cm x 3cm in size) in <5 minutes 20/20 trials. Aim 3: Demonstrate safety of BleedClear by verifying momentary contact (<3 sec) does not puncture gastric wall. Acceptance Criteria: BleedClear prototype contacting porcine gastric wall in simulated use results in no perforations in 20/20 trials.

Lynntech, Inc.
2501 Earl Rudder Freeway South, Suite 100
College Station, TX 77845

Contact: Hardin Russell Dunham
Phone: 1 (979) 764-2200
Web Site: http://lynntech.com/

Project Title: Wearable Device to Monitor Blood Alcohol Levels in Real Time

Related Award: 1 R43 AA024652-01

Technology Developed: Lynntech Life Sciences provides research expertise in molecular biology, cellular biology, biochemistry and bioinformatics. Through collaboration of these disciplines, we assemble diverse teams to execute biology-driven research. Utilizing proprietary software and advanced sensing units, we deliver diagnostic integrity for point-of-care interactions. With partners in major research sectors, Lynntech plays a fundamental role in the creation, execution and promotion of innovative medical technologies.

Public Health Relevance: Alcohol misuse in the U.S. has been estimated to cost upwards of $223 billion annually and cause approximately 1 in 10 deaths among working-age adults aged 20-64. It stands to reason that a device that cost-effectively enables its user to be more aware of his or her level of intoxication would help to reduce alcohol-related human and economic costs. To promote this type of user awareness, we propose to develop a wearable, integrated device platform that combines accurate and non-invasive blood alcohol measurement with easily accessible feedback using mobile device platforms.

Abstract: Alcohol misuse is linked to extensive economic costs as well as a large number of injuries and deaths. An estimated 16.6 million adults 18 and older had an alcohol use disorder (only one of which is Alcoholism) in 2013, amounting to ~$24.6 billion in healthcare costs. Additionally, nearly 88,000 deaths per year have been attributed to alcohol-related causes. Alcohol misuse is the number one leading risk factor for premature death for those aged 15-49, and the fifth leading risk factor for death overall. A high incidence of binge drinking (24.6% of

people 18 or older in 2013) is indicative of the underlying problem. In light of this, tools that help to prevent excessive alcohol consumption serve an important role in reducing the enormous human and socio- economic costs associated with alcohol misuse. The ability to responsibly and personally track Blood Alcohol Concentration (BAC) levels could result in a significant reduction of alcohol related injuries and deaths. In addition, patient compliance in terms of regular monitoring and reporting of BAC is one of the major concerns and needs for the treatment of Alcoholism. Currently, the most accurate method for measuring BAC is to directly and invasively sample the blood and perform an assay, and is therefore not amenable to widespread use. Non-invasive measurement of Breath Alcohol Concentration (BrAC) is popular but conspicuous, and of questionable accuracy (variable by ±50% from true BAC). Several non-invasive, wearable devices are available that measure Transdermal Alcohol Concentration (TAC). However, TAC is a poor reflection of BAC, being delayed by 30-90 minutes and prone to error by attempting to detect the small amount of alcohol that makes it to the skin. There is therefore a need for non-invasive measuring of BAC directly. Lynntech proposes to develop a wearable device that accurately and non-invasively measures BAC. The device will be programmable, unobtrusive, appealing to the wearer, and can take the form of a modern wristwatch that communicates with a mobile device to enable feedback and maintain user intoxication awareness. We hypothesize that, with lessons learned from the highly mature field of pulse oximetry, a true and direct measurement of BAC can be achieved using spectroscopy. In the Phase I, we have designed our aims with the goal of developing a prototype non-invasive BAC measuring device. These aims include: 1) developing the BAC measurement device hardware and software; 2) optimizing the BAC measurement using in vitro and ex vivo models; and 3) demonstrating accurate, real-time BAC measurement in vivo. A prototype device using high intensity LEDs and appropriate photodetectors will be designed and programmed. The assembled device will be used to demonstrate the feasibility of measuring alcohol content in the blood through a sample of porcine skin. Results will be used to optimize device design, configuration, and operation. Finally, the optimized device will be demonstrated in a mouse model to prove full feasibility.

Audiodontics, LLC
10401 Old Georgetown Road, Suite 310
Bethesda, MD 20814

Contact: Barry Mersky
Phone: 1 (301) 530-0701
Web Site: http://www.audiodontics.com/

Project Title: System for Monitoring Dental Device Compliance and Efficacy in Treatment of Obstructive Sleep Apnea

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Related Award: 1 R43 HL123090-01

Technology Developed: Audiodontics was founded with the belief that through the use of miniature electronics, a paradigm shift can occur which will allow novel electronic devices to be worn in the mouth. These devices can be developed to provide diagnostic and therapeutic solutions to vexing medical problems. Alternatively they can provide a means wireless voice communication and ubiquitous computing. Audiodontics envisions that through miniature electronic products, a new combination of the dental and medical fields will evolve which will result in new drug delivery methods and treatments for disorders as varied as hearing loss, speech pathology, and sleep apnea.

Public Health Relevance: This project shall deliver a new device and system for the nightly monitoring of compliance and efficacy of oral appliances that are used to treat Obstructive Sleep Apnea (OSA). It should lower the cost of current treatment methods that monitor OSA, and it can improve the public health and transportation safety through supplying this low-cost system for truck and commercial drivers who may have an OSA condition.

Abstract: Using novel audio hardware and specialized software this project shall research and develop a system that recognizes patterns of breath sounds within subjects who have sleep apnea hypopnea syndrome (SAHS) or most serious aspect - Obstructive Sleep Apnea (OSA). Upon completion (two Phases) of the project, the deliverable, called "Tooth Phone(R) System for Sleep Apnea Monitoring (TPS-SAM)", shall be a system that on a nightly basis, monitors the treatment compliance and efficacy of mandibular advancement devices (MADs) used to treat sleep apnea. To achieve the project deliverable the Phase I has four Specific Aims. They are: (Aim 1) Refine the audio hardware (tooth microphone) previously developed and integrate the tooth microphone into an oral appliance - specifically into a MAD, test for safety of the "integrated" MAD, and deliver several prototype data acquisition devices that record audio data from the integrated MAD; (Aim 2) Test the prototype devices and integrated MAD on human subjects in a sleep lab for (a) SAHS-event identification with audio, and (b) human factors such as comfort and ease of use; (Aim 3) Using specialized software previously developed, analyze the audio (tooth microphone) data files recorded in the sleep lab and identify events related to SAHS; (Aim 4) Contrast and compare the software results of Aim 3 against control microphone SAHS event identifications taken during sleep lab polysomnography (PSG). Phase I feasibility is achieved if the identification of SAHS events by the TPS-SAM system achieves an 85% accuracy (with 88 % sensitivity and 70 % specificity) when compared to the CONTROL estimation provided by PSG through analysis of standard parameters by sleep doctors. During Phase II the prototype shall be refined and audio data clinically correlated to standard PSG indicators of sleep apnea. If successful, benefits of this Project include: (1) Use of ONE sensor nightly to monitor SAHS, which potentially eliminates the need for subsequent titration PSGs, improves treatment efficacy, and lowers cost, (2) A new stand-alone system for patients at home to titrate oral appliances, (3) A system for researchers to compare the clinical effectiveness of different MAD designs, (4) An aid in long-term population studies of treatment effectiveness by

MADs for a specific level of OSA (mild, moderate, severe - as diagnosed by PSG - not by the proposed TPS-SAM), and perhaps most significantly, (5) The introduction of a novel hardware platform and automated computerized method to monitor ALL breath sounds (speech and non-speech), which in an era of Big Data and the NIH - BD2K initiative, can lead to an entirely new way to monitor and diagnose many respiratory illnesses and pathological conditions.

Procedures/Mechanisms HHS Has Used to Give Priority to Manufacturing-related SBIR Projects.

HHS SBIR/STTR announcements encourage development of new technologies as well as application of existing technologies. When appropriate, plans for manufacturing and clinical evaluation of developed technologies, drugs, devices and innovative approaches should be included in the application.

a) HHS released in the ***NIH Guide for Grants and Contracts*** several funding opportunity announcements (FOA) for manufacturing-related research:

NIH Funding Opportunity Announcement (FOA):

SBIR Phase IIB Bridge Awards to Accelerate the Development of Cancer Therapeutics, Imaging Technologies, Interventional Devices, Diagnostics, and Prognostics Toward Commercialization (R44)

http://grants.nih.gov/grants/guide/rfa-files/RFA-CA-15-010.html

This solicitation includes broad topic areas for HHS that is considered relevant to manufacturing-related R&D. Additional solicitations were issued as noted below:

Announcement Number	Title
RFA-HL-15-004	Bioreactors for Reparative Medicine (R41/R42)
RFA-HL-15-008	Bioreactors for Reparative Medicine (R43/R44)
PAR-16-027	SBIR/STTR Commercialization Readiness Pilot (CRP) Program: Technical Assistance and Late Stage Development (SB1)

b) Manufacturing-related SBIR/STTR research projects funded in FY 2015 awards (354 records) that were made in response to these solicitations and in response to the Omnibus SBIR/STTR Program Solicitations are appended to this report.

January 2015 SBIR/STTR Program Solicitations - Included within an IC's topic listings, topic areas specific to manufacturing-related areas in the PHS Omnibus Solicitation of the NIH, CDC, and FDA SBIR/STTR Grant Solicitation.

Actions HHS Has Taken Toward Promoting and Supporting Manufacturing-related Research Projects.

The HHS focused on the following procedures and mechanisms to give priority to manufacturing-related SBIR/STTR projects.

Ongoing: Outreach to raise awareness of **E.O. 13329** to the small business research community - Ongoing as part of presentations to small business applicants across the United States.

Ongoing: Promoting the manufacturing initiative through conferences, meetings, and website notices.

Ongoing: Tracking and reporting success stories on the NIH SBIR website that show the impact of the SBIR/STTR programs on manufacturing. See *SBIR and STTR Success Stories*.

National Aeronautics and Space Administration (NASA)

NASA's SBIR/STTR commitment to American manufacturing is demonstrated to be both ongoing and significant, and is expected to continue in the future. The programs support the research and technology needs of the Agency's Mission Directorates – Science, Human Exploration and Operation, Aeronautics Research, and Space Technology. These needs include searching for novel concepts and advanced capabilities at ever improving levels of efficiency.

New topics in NASA's solicitation for Phase I awards in FY 2015 that have future application to NASA' s mission needs, but also call out the need for advanced manufacturing related technology (including the development and production of new materials) included:

- A1.03 - Low Emissions Propulsion and Power
- A1.04 - Quiet Performance
- A2.01 - Flight Test and Measurements Technologies
- H1.01 - Regolith ISRU for Mission Consumable Production
- H2.01 - In-Space Chemical Propulsion
- H2.03 - High Power Electric Propulsion
- H2.04 - Cryogenic Fluid Management for In-Space Transportation
- H3.01 - Environmental Monitoring for Spacecraft Cabins
- H4.01 - Crew Survival Systems for Launch, Entry, Abort
- H4.02 - EVA Space Suit Pressure Garment Systems
- H5.01 - Deployable Structures
- H5.02 - Extreme Temperature Structures
- H5.03 - Multifunctional Materials and Structures
- H8.03 - Advanced Photovoltaic Systems
- H10.01 - Cryogenic Purge Gas Recovery and Reclamation
- H11.01 - Radiation Shielding Technologies
- H13.01 - Advanced NDE Modeling and Analysis
- H14.03 - Recycling/Reclamation of 3-D Printer Plastic Including Transformation of Launch Package Solutions into 3-D Printed Parts
- H20.01 - Solid and Liquid Waste Management for Human Spacecraft
- S1.03 - Sensor and Detector Technology for Visible, IR, Far IR and Submillimeter

- S1.04 - Detector Technologies for UV, X-Ray, Gamma-Ray and Cosmic-Ray Instruments
- S1.05 - Particles and Field Sensors and Instrument Enabling Technologies
- S1.07 - Airborne Measurement Systems
- S1.09 - Atomic Interferometry
- S1.10 - Cryogenic Systems for Sensors and Detectors
- S2.01 - Proximity Glare Suppression for Astronomical Coronagraphy
- S2.03 - Advanced Optical Systems and Fabrication/Testing/Control Technologies for EUV/Optical and IR Telescope
- S2.04 - X-Ray Mirror Systems Technology, Coating Technology for X-Ray-UV-OIR, and Free-Form Optics
- S20.01 - Novel Spectroscopy Technology and Instrumentation
- S3.01 - Power Generation and Conversion
- S3.02 - Propulsion Systems for Robotic Science Missions
- S3.03 - Power Electronics and Management, and Energy Storage
- S3.06 - Terrestrial and Planetary Balloons
- S3.07 - Thermal Control Systems
- S4.01 - Planetary Entry, Descent and Landing and Small Body Proximity Operation Technology
- S4.02 - Robotic Mobility, Manipulation and Sampling
- S4.03 - Spacecraft Technology for Sample Return Missions
- S4.04 - Extreme Environments Technology
- T1.01 - Affordable Nano/Micro Launch Propulsion Stages
- T12.03 - Advanced Bladder Materials for Inflatable Habitats
- T12.04 - Experimental and Analytical Technologies for Additive Manufacturing
- T6.01 - Gas Sensing Technology Advancements for Spacesuits
- T8.01 - Technologies for Planetary Compositional Analysis and Mapping
- Z2.01 - Large-Scale Polymer Matrix Composite (PMC) Structures, Materials, and Manufacturing Processes
- Z4.01 - Small Spacecraft in Deep Space: Power, Navigation, and Structures
- Z5.01 - Payload Technologies for Assistive Free-Flyers
- Z6.01 - Advanced Metallic Materials and Processes Innovation

Full Descriptions of these subtopics can be found at:

http://sbir.gsfc.nasa.gov/solicit/54565/detail?data=ch9&s=54495

http://sbir.gsfc.nasa.gov/solicit/54564/detail?data=ch9&s=54494, and
http://sbir.gsfc.nasa.gov/solicit/54564/detail?data=ch9&s=54496

Phase I awards associated with these subtopics are listed below:

Firm Name	Proposal Title	Contract #
Space Micro, Inc.	Development of a "Digital Bridge" Thermal Anemometer for Turbulence Measurements	NNX15CA30P
Energrid Technologies	Carbon Dioxide Collection and Pressurization Technology	NNX15CA48P
Flight Works, Inc.	High Heat Flux Block Ablator-in-Honeycomb Heat Shield Using Ablator/Aerogel-Filled Foam, Phase II	NNX15CC40P
Concepts to Systems, Inc.	Integration of Complex Geometry, 3D Woven Preforms via Innovative Stitching Technique	NNX15CC41P
MicroLink Devices, Inc.	High Efficiency Direct Methane Solid Oxide Fuel Cell System	NNX15CC53P
MicroLink Devices, Inc.	Fabrication of T-SOFC via Freeze Cast Methods for Space and Portable Applications	NNX15CC54P
Hyper Tech Research, Inc.	20 W High Efficiency 1550 nm Pulsed Fiber Laser	NNX15CC58P
Transition45 Technologies, Inc.	Large Format LW Type-II SLS FPAs for Space Applications	NNX15CC59P
Transition45 Technologies, Inc.	ZnMgO Nanowire Based Detectors and Detector Arrays	NNX15CC60P
Powdermet, Inc.	A Pulsed Nonlinear Raman Detection of Trace Organics with SERS Enhanced Sensitivity	NNX15CC63P
MicroLink Devices, Inc.	Advanced Mirror Material System	NNX15CC67P
FastCAP Systems Corporation	High-Efficiency, Radiation-Hard, Lightweight IMM Solar Cells	NNX15CC71P
Ultramet	Radioisotope Power Supply	NNX15CC73P
Ultramet	Additive Manufacturing of Ion Thruster Optics	NNX15CC74P
Freedom Photonics, LLC	Integrated Computational System for Electrochemical Device Design and Simulation	NNX15CD18P

Nanosonic, Inc.	Microblowing Technique for Drag Reduction	NNX15CD19P
Freedom Photonics, LLC	Toward Autonomous Stable Energy Management of Hybrid Electric Aircraft Propulsion Systems	NNX15CD20P
Optimax Systems, Inc.	Rugged, Compact, and Inexpensive Airborne Fiber Sensor Interrogator Based on a Monolithic Tunable Laser	NNX15CG20P
Incom, Inc.	High Sensitivity Semiconductor Sensor Skins for Multi-Axis Surface Pressure Characterization	NNX15CG22P
Ozark Integrated Circuits, Inc.	Integrated Optical Engine for Rugged, Compact, Inexpensive Airborne Fiber Sensor Interrogators	NNX15CG23P
Applied Material Systems Engineering, Inc. (AMSENG)	Robust Sensor for In-Flight Flow Characterization	NNX15CG25P
ElectroChem, Inc.	Microwave Extraction of Water from Boreholes in Regolith	NNX15CG26P
Optimax Systems, Inc.	Highly Efficient Electrochemical Cryogenic Purge Gas Recovery System	NNX15CG29P
Composite Technology Development, Inc.	High Hydrogen Thoraeus Rubber Gossamer Radiation Shielding for Human Protection	NNX15CG38P
Twinleaf, LLC	Epoxy/UHMWPE Composite Hybridized with Gadolinium Nanoparticles for Space Exploration	NNX15CG42P
Superconducting Systems, Inc.	Multifunctional Polyolefin Matrix Composite Structures	NNX15CG43P
Gloyer-Taylor Laboratories, LLC	Space Plastic Recycling System	NNX15CJ15P
Space Resources Extraction Technology	ORSC Methane Ascent/Descent Engine Technology Development	NNX15CJ16P
Kennon Products, Inc.	Low-Cost, Lightweight Transpiration-Cooled LOX/CH4 Engine	NNX15CJ19P
Air-Lock, Inc.	Bulk Nano-structured Materials for Turbomachinery Components	NNX15CJ23P
Quest Thermal Group	Thermo-Catalytic Ignition of Cryogenic Oxygen-Methane	NNX15CJ28P
Plasma Processes, LLC	Additive Manufacturing Applied to LOX - Methane Turbopumps	NNX15CJ36P
Nanosonic, Inc.	Rapid Manufacturing of High Power Electric Propulsion Components	NNX15CJ40P

Advanced Fuel Research, Inc.	Parahydrogen-Orthohydrogen Catalytic Conversion for Cryogenic Propellant Passive Heat Shielding	NNX15CJ46P
N5 Sensors, Inc.	Fabric, Inflated, Insulating Shroud for Cryogenic In-Space Transportation	NNX15CJ51P
Nanosonic, Inc.	Integrated Launch Vehicle - Load Responsive MLI: High Performance during Launch Ascent, In-Air, On-Orbit and On-Mars	NNX15CJ52P
Aerodyne Research, Inc.	Ultrasonic Additive Manufacturing for Multifunctional Structural Materials with Embedded Capabilities	NNX15CL30P
Applied Poleramic, Inc.	Room Temperature Electrolyzers For Oxygen Generation On Mars	NNX15CL36P
Gloyer-Taylor Laboratories, LLC	Radiation Hard, High Efficiency, Quadruple Junction Solar Cells Based on InGaAsN	NNX15CL40P
Sheridan Solutions, LLC	Light-Weight, Flexible, High Efficiency Vacuum Photo-Thermo-Voltaic Solar Cells	NNX15CL45P
Brimrose Technology Corporation	Type II SLS Materials Development for Space-based FPA Applications	NNX15CL50P
Summit Information Solutions, Inc.	Highly Scalable SiC UV Imager for Earth & Planetary Science	NNX15CL60P
TDA Research, Inc.	Space-Qualified Compact Optical Magnetometer	NNX15CL67P
Transition45 Technologies, Inc.	Electric Potential and Field Instrument for CubeSat (EPIC)	NNX15CL73P
Amchemteq, Inc	Curved Microchannel Plates for Spaceflight Mass Spectrometers	NNX15CL74P
Analytical Mechanics Associates, Inc.	eVADE: Volcanic Ash Detection Raman LIDAR	NNX15CL81P
Advanced Scientific Concepts, LLC	3-color DPAS Aerosol Absorption Monitor	NNX15CL84P
Ultramet	Robust Frequency Combs and Lasers for Optical Clocks and Sensing	NNX15CL85P
Texas Research Institute Austin, Inc.	Improved Yield, Performance and Reliability of High-Actuator-Count Deformable Mirrors	NNX15CL87P
Nanosonic, Inc.	Switching Electronics for Space-based Telescopes with Advanced AO Systems	NNX15CL88P

Materials Modification, Inc.	High Performance Consumer-Affordable Nanocomposite Mirrors with Supersmooth Surfaces, Precise Figuring, and Innovative 3D Printed Structures	NNX15CL98P
Arctic Slope Technical Services	Micropump for MON-25/MMH Propulsion and Attitude Control	NNX15CM22P
Techshot, Inc.	Wide Temperature, High Voltage and Energy Density Capacitors for Aerospace Exploration	NNX15CM23P
Applied Poleramic, Inc.	Wide Operating Temperature Range Ruggedized Ultracapacitor For Deep Space Exploration	NNX15CM25P
Barber-Nichols, Inc.	Advanced Onboard Energy Storage Solution for Balloons	NNX15CM27P
Optimax Systems, Inc.	Innovations for the Affordable Conductive Thermal Control Material Systems for Space Applications	NNX15CM29P
Paragon Space Development Corporation	3D Flash LIDAR Megapixel High Speed Array	NNX15CM38P
Florida Turbine Technologies, Inc.	Industrial Electrostatic-Gecko Gripper	NNX15CM40P
Apre Instruments, LLC	High Performance Nozzle for Mars Ascent Vehicle	NNX15CM44P
Plasma Processes, LLC	Ultra-High Temperature Solid State Ultracapacitor Operating at 300C For Extreme Environments	NNX15CM46P
Dallas Optical Systems, Inc.	Extreme Environment Electronics based on Silicon Carbide	NNX15CM50P
Keystone Synergistic Enterprises, Inc.	Thermodynamically Consistent Electrochemical Models for Accelerating Development and Qualification of Power Generation and Storage Systems	NNX15CM53P
Ultramet	Resin Infusion Fabrication of nanostructured PMC	NNX15CM57P
Ultramet	Infusion Resins for Automated Dry Fiber Placement Products	NNX15CM58P
Special Aerospace Services	Radiation Tolerant Integrated Attitude Determination and Control (uADCS) System	NNX15CM61P
Lightweight Telescopes, Inc.	Robotic Arm for Assistive Free-Flyers	NNX15CM63P
Mound Laser & Photonics Center, Inc.	Advanced Solid-State Joining Processes for 2219 Aluminum Alloys	NNX15CM64P

Mound Laser & Photonics Center, Inc.	A Low-Cost Method for Coating of Selective Laser Melting (SLM) Manufacturing of Complex High-Precision Components for Spaceflight Applications Using Atomic Layer Deposition (ALD)	NNX15CM65P
Garvey Spacecraft Corporation	Torrefaction Processing for Human Solid Waste Management	NNX15CM66P
Gloyer-Taylor Laboratories, LLC	olyStrata Greenhouse GasRadiometer for Small Satellite Applications	NNX15CM67P
Keystone Synergistic Enterprises, Inc.	ACE Booster	NNX15CM68P
Parabilis Space Technologies, Inc.	Multifunctional Shielding and Self-Healing HybridSil Smart Composites for Space	NNX15CM69P
Sheridan Solutions, LLC	In-Process Monitoring of Additive Manufacturing	NNX15CP21P
InnovaPrep, LLC	Heat Harvesting by Artificial Muscles	NNX15CP23P
Sunlite Science & Technology, Inc.	Compact Energy Conversion Module	NNX15CP36P
Boston Micromachines Corporation	Dynamic ASE Modeling and Optimization of Aircraft with SpaRibs	NNX15CP39P
IntelliEPI IR, Inc.	Distributed, Passivity-Based, Aeroservoelastic Control (DPASC) of Structurally Efficient Aircraft in the Presence of Gusts	NNX15CP46P
Somatis Sensor Solutions	An End-To-End Microfluidic Platform for Engineering Life Supporting Microbes in Space Exploration Missions	NNX15CP47P
UNITED SILICON CARBIDE, INC.	High Performance Hybrid Upper Stage for NanoLaunch Vehicles	NNX15CP48P
FastCAP Systems Corporation	Advanced Hybrid Stage	NNX15CP59P
Vescent Photonics, Inc.	NLV Upper Stage Development and Flight Testing	NNX15CP65P
Nuvotronics, LLC	Ultra Low Air and H2 Permeability Cryogenic Bladder Materials for Inflatable Habitats	NNX15CP66P
Sustainable Innovations, LLC	High Figure-of-Merit Macro-Structured Thermoelectric Materials	NNX15CS11P
Wavefront, LLC	ShortWave Infrared Focal plane Technology for Close-range Active Mineralogy Mapping (SWIFT-CAMM)	NNX15CS57P

Encouraging Innovation in Manufacturing
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Phase II awards made in FY 2015 associated with subtopics solicited for Phase I in FY 2014 include:

Firm Name	Proposal Title	Contract #
MesoScribe Technologies, Inc.	Recession-Tolerant Sensors for Thermal Protection Systems	NNX15CA01C
T.E.A.M., Inc.	Handheld Electronics EHM Sensor Probe for Determination of Remaining Useful Life	NNX15CA08C
Crystal Research, Inc.	Adaptive Liners for Broadband Noise Reduction	NNX15CA12C
Ultramet	Compact Kinetic Mechanisms for Petroleum-Derived and Alternative Aviation Fuels	NNX15CA17C
Nokomis, Inc.	Robust High Temperature Environmental Barrier Coating System for Ceramic Matrix Composite Gas Turbine Components using Affordable Processing Approach	NNX15CA20C
Applied Optimization, Inc.	Oxygen-Independent Pressure Sensitive Paint	NNX15CA24C
Yanhai Power, LLC	A Low-Power Medical Oxygen Generator	NNX15CC12C
Mark O'Neill, LLC	STARwatch to Deliver Objective Sleep Measures for Spaceflight Operations	NNX15CC14C
LaunchPoint Technologies, Inc.	Fast Acting Flow Control Valve	NNX15CC15C
TDA Research, Inc.	100-lbf Non-Toxic Storable Liquid Propulsion	NNX15CC17C
Plasma Processes, LLC	Cellular Load Responsive MLI: Structural In-Air and In-Space LH2 Insulation	NNX15CC18C
MicroLink Devices, Inc.	Fabrication and Testing of Nuclear-Thermal Propulsion Ground Test Hardware, Phase II	NNX15CC20C
ORMOND, LLC	Highly Efficient, Solid State Hydrogen Purification for Resource Recovery	NNX15CC21C
Plasma Controls, LLC	An Advanced Smoke-Eater for Post-Fire Cabin Atmosphere Cleanup	NNX15CC22C
Ultramet	Non-Intrusive, Distributed Gas Sensing Technology for Advanced Spacesuits	NNX15CC24C
MicroLink Devices, Inc.	Laser-Directed CVD 3D Printing System for Refractory Metal Propulsion Hardware, Phase II	NNX15CC26C

Directed Vapor Technologies International, Inc	Spirally Stowed Architecture for Large Photovoltaic Arrays	NNX15CC29C
Physical Sciences, Inc.	Ultra-Flexible Advanced Stiffness Truss for Large Solar Arrays	NNX15CC35C
Tao of Systems Integration, Inc.	>1,000 W/kg Rad-Hard, High-Voltage PV Blanket at < $50/W IMM Cell Cost	NNX15CD07C
M4 Engineering, Inc.	Ultra-High Energy Solid-State Batteries for Next Generation Space Power	NNX15CD08C
Structured Materials Industries, Inc.	High Performance Carbon Nanotube Based Conductors	NNX15CG10C
Triton Systems, Inc.	Shape Memory Alloy Adaptive Structures	NNX15CG11C
AOSense, Inc.	Miniaturized Dynamic Pressure Sensor Arrays with Sub-Millimeter (mm) Spacing for Cross-Flow Transition Measurements	NNX15CG12C
Pulsar Informatics, Inc.	Novel Approach In Fabrication Of Shielding Composite Materials By Emerging Field Assisted Sintering Technique (FAST)	NNX15CJ05C
TDA Research, Inc.	Multifunctional BHL Radiation Shield	NNX15CJ07C
Intelligent Optical Systems, Inc.	Multifunctional Structural Composites for Radiation Shielding	NNX15CJ09C
Aurora Flight Sciences Corporation	NDE Big Data Framework	NNX15CJ13C
Nanosonic, Inc.	High Pressure Electrochemical Oxygen Generation for ISS	NNX15CJ14C
Gloyer-Taylor Laboratories, LLC	Light Weight Insulated Spherical Cryotank	NNX15CK06C
COSM Advanced Manufacturing Systems, LLC	Lightweight, Compact Survival Rafts	NNX15CL08C
L'Garde, Inc.	Self-Healing, Self-Diagnosing Multifunctional Hybridsil Composites for EVA Space Suit Pressure Garment Systems	NNX15CL10C
Vigyan, Inc.	Contact Stress Design Parameters for Titanium Bearings	NNX15CL11C
TentGuild Engineering Company	X-Boom	NNX15CL17C

Intelligent Optical Systems, Inc.	Rapid Manufacturing of Durable, Cost-Effective Ceramic Matrix Composites for High Temperature Structures	NNX15CL21C
Allcomp, Inc.	Multifunctional Tank Structure with Integral TPS	NNX15CL23C
Mound Laser & Photonics Center, Inc.	Metallic Joining to Advanced Ceramic Composites	NNX15CL28C
Cornerstone Research Group, Inc.	Additive Manufactured Very Light Weight Diamond Turned Aspheric Mirror	NNX15CM04C
Tethers Unlimited, Inc.	Additive Manufacturing for Lightweight Reflective Optics	NNX15CM06C
Sustainable Innovations, LLC	Low Coherence, Spectrally Modulated, Spherical Wavefront Probe for Nanometer Level Free-Form Metrology	NNX15CM07C
ORMOND, LLC	Manufacture of Monolithic Telescope with a Freeform Surface	NNX15CM09C
The Peregrine Falcon Corporation	Flexible ELO Solar Cells with Ultra-High Specific Power and Areal Power Density	NNX15CM10C
WASK Engineering, Inc.	Large-Area, Multi-Junction, Epitaxial Lift-Off Solar Cells with Backside Contacts	NNX15CM11C
Quest Thermal Group	Low-Cost, Lightweight, High-Performance CMC Combustion Chamber for HAN-Based Monopropellant Engines	NNX15CM13C
Environmental and Life Support Tech.	Green Monopropellant Secondary Payload Propulsion System	NNX15CM14C
Polaronyx, Inc.	Automated Manufacture of Damage Detecting, Self-Healing Composite Cryogenic Pressure Vessels	NNX15CP02C
IntelliEPI IR, Inc.	Physics and Statistics Based Selection of SLM and EBM Process Parameters to Mitigate Defects and to Control Deposit Microstructure	NNX15CP11C
Ultramet	Metal Digital Direct Manufacturing (MDDM) for Close-Out of Combustion Chambers and Nozzle Fabrications	NNX15CS02C
Lynntech, Inc.	Real-Time Geometric Analysis of Additive Manufacturing	NNX15CS05C

In further support of manufacturing related efforts, NASA's Space Technology Mission Directorate (STMD) continues to invest in lower Technology Readiness Level (TRL) development of enhanced and novel manufacturing processes and tools. Manufacturing remains critical to all NASA missions and STMD utilizes the SBIR/STTR program as one mechanism in achieving manufacturing affordability for complex components for our

missions as well as providing an avenue for small businesses to push the envelope in developing multifaceted and critical materials and manufacturing tools and processes.

By leveraging NASA's in-house capabilities, industry has the opportunity to develop and use facilities and expertise as testing grounds and pathfinders for many of NASA technological needs. From the manufacturing feats on the Mars Curiosity Rover, James Webb Space Telescope, and "Composite Cryo tank" project to initiatives for Rocket Engine additive manufacturing, NASA has enhanced the manufacturing capabilities of small and large firms partnered through many avenues, including SBIR/STTR.

NASA's SBIR/STTR programs fulfill mandated requirements encouraging innovation in manufacturing. The annual Solicitations include the following text:

> This solicitation complies with Executive Order 13329 (issued February 26, 2004) directing Federal agencies that administer the SBIR and STTR programs to encourage innovation in manufacturing related research and development consistent with the objectives of each agency and to the extent permitted by law. In response to this Executive Order, NASA encourages the submission of applications that deal with some aspect of innovative manufacturing technology. If a proposal has a connection to manufacturing this should be indicated in the Part 5 (Related R/R&D) of the proposal and a brief explanation of how it is related to manufacturing should be provided.

National Science Foundation (NSF)

Examples of Manufacturing-related SBIR Projects.

Firm Name	Award Title	Award Amount	Phase
MOBOSENSE LLC	A Smartphone-Based Handheld Sensor for Accurate and Quantitative Detection of Toxic Ion Contaminants in Environmental Water	$149,880	I
Eclo, Inc.	Virtual Footwear Fitting System	$149,197	I
PolyInsight, LLC	Scaling up the Synthesis of Novel Poly(ethylene glycol) Based Dendrimers for Targeted Drug Delivery Applications	$749,747	II
NanoAl LLC	Designing New Economical High-Temperature Aluminum Superalloys	$149,866	I
FTL Labs Corporation	Interactive Multi-Touch Collaborative Table for Classrooms	$652,450	II

Award Detail

Awardee: **MOBOSENSE LLC**
Award Title or Description: SBIR Phase I: A Smartphone-Based Handheld Sensor for Accurate and Quantitative Detection of Toxic Ion Contaminants in Environmental Water
Award Date: 06/15/2015
Award Amount: $149,880
Start Date: 07/01/2015
End Date: 12/31/2015

Abstract at Time of Award

The broader impact/commercial potential of this project is a portable, low-cost plug and play mobile internet integrated sensor product catering to the needs of water quality monitoring market, a global market with a compounded annual growth rate of 4-6%. The water testing equipment market is divided into low-end, low-cost

on-field test equipment (such as nitrate strip) that gives qualitative information about the analytes, and high-end testing devices used in labs (such as mass spectrometer) providing accurate quantitative information. If successful, this sensor technology will bridge the gap by providing low-cost, sensitive, accurate tools for quantitative measurement of analytes such as toxic ions. Consequently, successful demonstrations of the proposed sensor technology will facilitate wider market acceptance and penetration of personalized mobile-enabled water quality monitoring devices. Another aspect of the project is to enable citizen scientist to partake in environmental data collection and spread sustainability education.

This Small Business Innovation Research (SBIR) Phase I project proposes to develop a smartphone-based electrical sensor technology for real-time water quality monitoring. Currently, spectrometry, capillary electrophoresis, chemical reduction methods, and gas chromatography coupled mass spectroscopy are some of the most widely used techniques for water quality analysis; however, these instruments are bulky and costly; the methods are time consuming, and involve laborious sample processing steps requiring well-trained personnel in a laboratory setting; In order to meet the market need for a portable, low-cost, and easy-to-use water analysis technology, the project will investigate a smartphone integrated electrical readout sensor platform which will be able to address all of the above issues by: 1) the development of a low-cost, portable sensor package consisting of an electrochemical sensor chip, a driver circuit, and rechargeable battery power for standalone operation; 2) the application of polymer immobilized ion sensing coatings to increase the selectivity during ion detection in a non-laboratory setting; 3) the use of algorithm against calibration curve to automatically detect and quantify toxic ion, and 4) the use of smartphone in-built GPS and mobile broadband function to combine the sensing results with geospatial information and uploaded to the Cloud for further analysis.

Awardee: Eclo, Inc.
Award Title or Description: Virtual Footwear Fitting System
Award Date: 12/18/2014
Award Amount: $149,197
Start Date: 01/01/2015
End Date: 09/30/2015

Abstract at Time of Award

The broader impact/commercial potential of this Small Business Innovation Research (SBIR) Phase I project is in addressing one of the most common problems associated with ordering clothing and shoes online, which is the inability to know how things will fit. The technology being developed is a virtual footwear fitting system (VFFS) utilizing a user's own foot geometry. The virtual fitting experience will give size recommendations based on comfort levels and support levels for different shoe models. This will reduce the 35% return rate of online footwear

retailers and thereby reduce their estimated $1.5 billion in annual losses in the US alone. Reducing the risk factor associated with online ordering will help people benefit fully from the convenience and large selection of online retailers. The reduction in return rate will reduce the carbon footprint of some 30 million annual returns. The VFFS will be available to the masses and will create a large exposure for 3D modeling fields such as computer aided design, finite element analysis and computer vision. 3D scanning with smartphones has endless applications, and the virtual fitting technology will help make computer vision principles more adapted for those applications. Virtual fitting opens the doors for mass customization, which is the future of footwear and garments. The technology will help bring our society closer to a world where things are tailored for us, convenient and affordable. This project focuses on the development of a virtual footwear fitting system to reduce the return rate of online retail. The system consists of a foot scanner, shoe scanner and fitting algorithm. Online shoppers will use their smartphones to scan their feet and obtain a 3D model. A photogrammetry algorithm is being developed for this specific application. It utilizes feature recognition of the foot along with smartphone acceleration outputs to construct a 3D model with 1 mm accuracy in different image capturing environments. An adaptive inner volume (AIV) scanner is being developed to scan the inner volume of shoes that is combined with an outer scan to give a 3D shoe model with 0.5 mm accuracy along with material stiffness. The fitting algorithm will compare foot and shoe scans to perform a comprehensive fitting analysis giving online shoppers a way to know what shoe size they need and how comfortable their potential purchase will be. By the end of this project, a basic virtual fitting platform will be developed. It will allow a user to scan his or her foot with an iPhone and obtain a size recommendation for a specific shoe within ¿0.5 size of his or her personal choice based on comfort levels, support levels and fit preferences.

Awardee: Polysight LLC
Award Title or Description: SBIR Phase II: Scaling up the Synthesis of Novel Poly(ethylene glycol) Based Dendrimers for Targeted Drug Delivery Applications
Award Date: 04/08/2014
Award Amount: $749,747
Start Date: 04/15/2014
End Date: 03/31/2016

Abstract at Time of Award

This Small Business Innovation Research Phase II project is aimed at the design and manufacture of agents useful for the diagnosis and treatment of breast and other cancers. The primary product is a novel water-soluble molecule constructed from poly(ethylene glycol) (or PEG), containing multiple arms with folate groups as well as a diagnostic agent. The folate groups will target cancer cells preferentially over healthy cells and the fluorescent

diagnostic agent will allow effective breast cancer diagnosis. This targeting molecule differs from currently available materials in that the length and number of the PEG arms as well as the attachment of folate groups can be very carefully and reproducibly controlled, addressing a critical weakness with previous multifunctional devices. The precision synthesis steps are catalyzed by an enzyme, leading to very pure products. Currently three folate-targeted diagnostic molecules are in Phase III clinical trials, but all are based on small molecules and a single folate targeting group. The advantage of a polymer-based device with multiple folate groups will be a longer circulation time in the body with more effective targeting of cancer cells.

The broader impact/commercial potential of this project is significant since by 2020 approximately 18.2 million Americans will be diagnosed with cancer. Breast cancer is the most frequently diagnosed cancer in both white and African-American women. One in eight American women develops breast cancer, and a new patient is diagnosed in every three minutes. Chemotherapy has many side effects such as hair loss and nausea, and requires extended patient care. Specific targeting is a significant advantage for diagnostic and chemotherapeutic agents. When a drug is delivered directly to the cancer cell to kill it, the collateral damage of healthy cells is minimized. New delivery devices are badly needed for cancer diagnosis and therapy, and if successful this project will provide both a new diagnostic agent as well as a platform technology for additional products. Another impact of this project is the use of an enzyme-catalyzed green manufacturing process which minimizes wasteful by-products. In the longer term, the market potential will be significant as the technology is adapted to specific diagnostic and therapeutic products.

Awardee: NanoAl LLC
Award Title or Description: SBIR Phase I: Designing New Economical High-Temperature Aluminum Superalloys
Award Date: 05/19/2014
Award Amount: $149,866
Start Date: 07/01/2014
End Date: 12/31/2014

Abstract at Time of Award

This Small Business Innovation Research Phase I project involves development of a new class of lightweight aluminum superalloys to replace much heavier cast iron in automobile brake rotors. There is a large market for brake rotors, estimated worldwide at $10 billion. Replacing four cast iron brake rotors in a typical sedan will reduce its weight by about 80 pounds, which translates into significant improvements in gas mileage and reductions in tailpipe emissions. These advantages are anticipated to be compelling to automakers, because of the new U.S. Corporate Average Fuel Economy (CAFE) rules. If successful, the new aluminum superalloys can capture a 2.5% share of the brake-rotor market, equivalent to 25 million brake rotors per year, during the

replacement cycle. Other benefits of the switch to aluminum alloy brake rotors include: (a) rapid heat dissipation from the brake surface; (b) faster stopping and acceleration, and better automobile handling; (c) much higher corrosion resistance due to the usage of aluminum; and (d) the elimination of corrosion products (rust which forms on cast iron rotors leads to inhomogeneous heat distribution during braking).

Current commercial lightweight age-hardenable aluminum alloys are not useable above 220 degrees C because the strengthening precipitates dissolve. Thus, there is no widespread commercial usage of aluminum alloys for applications that involve elevated temperatures; e.g., automotive brake rotors. A first alternative is aluminum alloys containing 0.15-0.30% by weight of scandium (which contains heat- and coarsening-resistant Al3Sc precipitates). Another alternative is aluminum-matrix composites with ceramic particles or fibers. The former contain, however, an expensive element (scandium is comparable to gold in price) and the latter involve complicated and expensive processing routes, respectively, severely limiting their usage. The goal of Phase I is to develop successfully and patent new proprietary alloy compositions and heat treatment procedures to produce Sc-free aluminum superalloys able to sustain months of exposure at 400 degrees C and above, without a significant loss of strength. We will also manufacture a prototype brake rotor, in order to further prove out this material.

Awardee: FTL Labs Corporation
Award Title or Description: SBIR Phase II: Interactive Multi-Touch Collaborative Table for Classrooms
Award Date: 08/24/2013
Award Amount: $652,450
Start Date: 09/01/2013
End Date: 12/31/2015

Abstract at Time of Award

This Small Business Innovation Research (SBIR) Phase II award proposes to develop a multi-touch table with object tracking and smart surface devices to create a highly versatile augmented-reality lab bench. The resulting instrument allows collaborative experimentation using physical lab equipment such as ballistic pucks, microscopes, beakers, and hot plates, combined with real-time measurement, analysis, and graphical content. Working with Tufts University and area educators, a new model of lab equipment has been demonstrated. The effective use of affordable technologies provides the access, supports, and scaffolds that students need to make sense of science and become excited by STEM (Science Technology Engineering and Math) creative opportunities. STEM-Table will be used in conjunction with traditional instruction, but leverage a wide range of new multimedia enhanced interactions, thereby transforming the STEM classroom into a more hands-on and responsive environment and elucidating the connections needed for fuller scientific understanding.

The broader/commercial impact is that (1) creating the classroom-ready, large-format, multi-touch STEM-Table brings unique, tangible interactive experiences to STEM Teaching Labs; (2) multi-touch STEM lab equipment enables a wide range of learning that combines data collection and hands-on lab skills with virtual media; and (3) the multi-touch environment will provide classrooms with a new paradigm for collaborative STEM activities with cost, capabilities, and workload reduction advantages. In the proposed work a fully-commercialized STEM Table "Multi-Science Augmented Reality Lab Bench" product will be deployed with associated tangible lab equipment surface devices. This technology will be classroom-tested and a user community will be supported with expanded applications. Based on the user and market reaction to the core technology evaluated to-date, this product will provide both a strong market position among current educational lab equipment and significant STEM education benefits.

Appendix A – Examples of DOD Manufacturing-Related SBIR/STTR Projects

Component: Air Force
Firm: Texas Research Institute Austin, Inc.
Project Title: Residual Stress Determination for Cold Expanded Holes
Award Amount: $150,000
Project Summary: Cold working has been used for holes in aircraft structure to extend fatigue life for decades. This procedure can be used as a terminating action or as an inspection interval extension. To have confidence in the process, the Air Force needs an inspection tool that can conclusively determine of the cold work process has been applied to a hole, and if the results are within process specifications. TRI/Austin has already developed a prototype tool, the FastenerCam™, that performs this inspection on straight shank holes, using a contact fixture. In this effort, we will enhance the FastenerCam™ by making it non-contact, and by developing the analysis software to assess countersunk holes. The Air Force currently allows only a conservative approximation of the benefit of cold working fastener holes. The FastenerCam™ ensures that holes have been properly cold worked, allowing extension of inspection intervals, and often elimination of inspections for the life of structure. A review of the A-10 shows that 25% of the 120 inspection locations specified in Durability and Damage Tolerance Analysis involve cold worked holes. Eliminating only one inspection cycle for each of these locations would result in lower cost and increased availability, and this can be applied across all Air Force fleets. Component: Air Force Firm: TDA Research, Inc. Project Title: Chromate-Free Fuel Tank Coating Award Amount: $150,000 Project Summary: Current aircraft fuel tank coatings provide excellent corrosion protection but do so by incorporating chromates. Unfortunately, these hexavalent chromates are known carcinogens and their use and disposal is strictly regulated. An ideal aircraft fuel tank coating would provide effective corrosion protection without the use of chromates. TDA will develop a chromate free, room temperature curing fuel tank coating using novel corrosion inhibitor additives. TDA has developed a new class of corrosion inhibiting materials that can dramatically increase the corrosion protection performance through a targeted extended release mechanism. In the Phase I project we will work with a major coating manufacturer to incorporate our corrosion inhibitors into a AMS-C-2775 fuel tank coating resin system to provide a coating whose protections equals that of the current system but contain no chromate. The chromate free polyurethane fuel tank coatings are applicable to commercial as well as military aircraft. Further, the non-chromated corrosion inhibitor additives developed in this project can be used in military and commercial primers and coatings wherever corrosion protection is required. They could be used for corrosion protection for metals employed in a wide range of applications, including automotive, aerospace, bridges and

building. They will provide effective corrosion protection without the health and environmental hazards of hexavalent chromates.

Component: Air Force
Firm: Solid Concepts, Inc.
Project Title: Implementation of Direct Metal Laser Sintering (DMLS) to Manufacture Monel K500 Liquid Rocket Engine Components
Award Amount: $150,000
Project Summary: Hydrocarbon Boost (HCB) is Aerojet- Rocketdyne's technology demonstration program for the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) effort. The HCB program will establish the knowledge for the first American oxygen rich staged combustion engine. LOX rich engines contain harsh environments due to cryogenic temperatures and high oxygen concentration. MonelK500 is favored as a LOX compatible alloy. Even at high pressures it will not sustain a flame in an oxygen rich environment. The HCB program's current demonstration of the subscale LOX rich pre-burner is made of several K500 components. However, conventional manufacturing methods did not provide a practical means to optimize design, reduce lead time, or lower cost. Direct Metal Laser Sintering (DMLS) is an additive process capable of producing complex geometry using one method. DMLS sequentially spreads layers of powder metal and selectively melts regions defined by a 2D slice of a 3D CAD model. Theoretically any geometry can be built. Solid Concepts is one of the most technically advanced suppliers of Direct Digital Manufacturing services. Their DMLS department specializes in aerospace components and produces parts pushing the technology's limits. Solid Concepts Phase 1 goal will assess the feasibility of implementing DMLS to manufacture MonelK500 liquid rocket engine components. The ability to develop advanced liquid rocket engine (LRE) components with Direct Metal Laser Sintering (DMLS) will provide a significant increase in design freedom thereby enabling reduced weight and improved function, with minimal cost and shorter lead times to next best alternative. The capability to reduce weight, improve function is to enable better thrust to weight ratio and create a better performing rocket engine. DMLS provides a means to optimize design thereby maximizing performance, while minimizing the risk associated with manufacturing. Tangible parts can be fabricated within days. Engineering design changes can be implemented, built, and experimentally tested within two weeks with little to no additional cost. The technique has no associated tooling cost making it highly beneficial to programs requiring low volume production of complex parts. This is an ideal situation when LRE components are only needed 10 to 12 times per year. Rocket Engine companies will be able to design and produce lighter weight components of increased complexity at an increased rate. This phase 1 project will develop additive K500 and establish the knowledge base establishing an industry around additive manufacturing LRE components.

Encouraging Innovation in Manufacturing
FY2015 Annual Report

Component: Army

Firm Name: Technology Solutions Experts Inc. (TSE)

Project Title: Algorithms for Ground Soldier Based Simulations and Decision Support Applications

Award Amount: $1,229,995

Project Summary: There is an increasing need among military organizations for methodologies and algorithms that enhance realistic autonomous agent behavior in constructive modeling and simulation. Application and understanding of real-world elements will be essential in identifying the decisions to support and represent important factors such as METT-TC. TSE's goals for the research, development, and commercialization tasks required to achieve the following Phase II objectives include: (1) design a formal knowledge model of battlespace Small Combat Unit (SCU) entities and relationships, expressed with symbolic logic; (2) develop methodologies for SCU decision making and behavior control that work with this formal knowledge model; (3) implement prototype software for intelligent agent behavior and integrate into an existing SCU constructive combat simulation; and (4) design a prototype for SCU command and Soldier decision support tools. TSE's commercialization strategy incorporates applications for this technology in various government and commercial industries, such as law enforcement and emergency response. These sectors will benefit from improved planning and decision making. TSE's design and development approach will provide developers of current and future modeling and simulation packages the ability to implement and extend new capabilities for their respective applications. Decision support tools technologies developed by TSE through this SBIR award can be transitioned into commercial mobile game-based learning products. Component: Army Firm Name: HyPerComp, Inc. Project Title: Automated Preparation of Geometry Models for Computational Applications Award Amount: $ 929,948 Project Summary: In this Phase II effort, HyPerComp, Inc. seeks to develop and integrate CAD repair algorithms with their existing highly capable geometry manipulation and grid generation software with the goal of greatly decreasing the time spent generating grids for complex geometry configurations as part of the numerical simulation problem setup. Highly detailed CAD models are critical for design and manufacture of a wide variety of geometries, from antennas to vehicles, bridges and buildings. However, in many cases, small features in the CAD model are not needed for the numerical simulations carried out using those models, such as those involving structural mechanics, fluid dynamics, or electromagnetics. De-featuring, or simplifying CAD models and performing associated clean-up of the geometry entities remains a large bottleneck in the simulation process. In addition, deficiencies exist in exchanging data among CAD tools. Computational engineers may also spend a large amount of time setting up and performing surface and volume grid generation to obtain grids that form the input to computational solvers. This effort focuses on methods to greatly reduce the entire CAD to mesh process using new and existing technology developed at HyPerComp, or open source solutions, if available. HyPerComp, Inc. intends to make their geometry manipulation and grid generation software available to government agencies and commercial customers involved in computational physics simulations. As numerical solvers become easier

to use, more accurate, commonly available, and able to harness ever increasing computing power, the demand for CAD repair and meshing tools that are optimized and customized to setup these simulations will grow. Successful implementation of the goals of this effort will make a highly marketable product, as well as an invaluable companion tool to many computational physics solvers.

Component: Army
Firm Name: Wizbe Innovations
Project Title: Fabric with Variable Air Permeability for Use in Parachutes
Award Amount: $1,229,826
Project Summary: Wizbe Innovations has developed a fabric with controllable air flow. This system used in parachutes has the potential to reduce opening shock, the time in the air, stability, directional control, and the landing speed. During this Phase II effort, further development of the concepts derived in Phase I are being pursued with the ultimate goal to demonstrate the technology on prototype parachutes. Wizbe Innovations and its partners are working to develop, demonstrate, and deliver a parachute prototype that has the ability to actively change air permeability upon application or removal of a trigger mechanism. Parachutes are a vital technology for getting Warfighters, ammunition, and other supplies to the battlefield. Personnel parachutes provide life support for paratroopers and are part of the ejection seat of aircraft for the pilot. Cargo parachutes are used to drop military equipment from aircraft. Many aircraft also use deceleration parachutes to slow down. For disaster relief, a parachute may also be used for delivering medicines, goods and other supplies to isolated victims. The ability to actively control porosity in fabrics has many applications including parachutes, clothing, shelters, sails, and filtration products. The first priority is to develop parachute fabrics to be used in new parachute designs. Wizbe Innovations will provide the fabric to parachute manufacturers such as Pioneer Aerospace who will design and produce parachutes. This technology would be applicable to traditional round parachutes, new low cost chutes, as well as parafoil guided parachute systems.

Component: OSD
Firm: Pacific Science & Engineering Group, Inc.
Project Title: Contextual Anomaly Management Interface (CAMI) for Autonomous Systems **Award Amount:** $1,797,900
Project Summary: To deal with the increasingly complex, dynamic and unpredictable operational environments of the 21st century, unmanned and autonomous system, sensor, and vehicle technologies are being expanded and improved. For example, unmanned air, ground, and maritime systems provide an expanding set of capabilities, such as intelligence, detection, security, targeting, and strike, while reducing the risk to human life. The goal with the employment of these systems is to shift from today’s manpower-intensive model of unmanned

system control to a future model with fewer users who are supervising autonomous systems (1). However, to achieve this goal, a significant issue that needs to be addressed is determining how users can, and should, supervise these multiple autonomous systems in future environments that are unpredictable, complex, and highly dynamic. A key technology that can help users supervise these autonomous systems is the development and maturation of machine-based anomaly detection, to detect and characterize significant anomalous behaviors that might emerge within an on-going mission and task context. This technology can help users supervise systems by drawing users' limited attention to just the most critical, anomalous events and will be a key enabler to reducing the manpower required to manage autonomous systems by monitoring for anomalous events currently performed by humans. The focus of this effort is to make the anomaly detection technology relevant and useful to the future human supervisor. The output of this effort should define, structure, and enable efficient information transactions between users and the anomaly detection technology. Research will be needed to inform the development of system behavior anomaly detection algorithms, including models of system normalcy, deviations from normalcy, and mission context. A central challenge in this domain will be determining what behavior constitutes significant deviations from normal behavior. Deviations in the face of dynamic missions, and operational contexts is difficult to define, and must be relevant to the human user supervising the system. The model must be tailored to needs of user tasks and decisions, and tuned to optimize trust in automation (2, 3, and 4) and avoid the documented pitfalls of automation (5, 6). A user interface layer and an associated business process will be needed to structure and enable interactions between users and anomaly detection algorithms. The proposed research will develop techniques to enable the detection of anomalies in the behavior of command and control systems. The desired solution should be applicable to anomaly detection in a variety of command and control domains, such as multi-echelon military command and control, and the management of multiple autonomous vehicles and systems. For example, for the management of multi-UAV systems, the algorithms will detect anomalies to either make corrections within the UAVs' mission scope or alert the operator and provide alternative courses of action. Resultant capabilities are expected to produce cost savings through a reduction in manpower, as Autonomous Warfare evolves from multiple operator vehicles with teams of human controllers, to a single operator managing multiple systems.

Component: OSD
Firm: Advanced Cooling Technologies, Inc.
Project Title: Environmental Control Unit with Integrated Thermal Storage
Award Amount: $ 999,758
Project Summary: Military Environmental Control Units (ECUs) represent one of the dominant energy users in forward operating environments, and significant effort is being made to improving overall ECU efficiency [1]. Reducing overall Size, Weight and Power (SWaP) of military ECU's is complicated by the transient, yet

predictable, nature of the thermal demand profile over the course of a typical daily usage cycle, where cooling capacity must currently be set to match the daily peak load. This need for cooling unit excess-capacity creates trickle-down effects of increasing installed power generation requirements and logistic transport burdens. ECU capacity “right-sizing” can help meet Operational Energy Strategy requirements for improved net energy efficiency, but will demand significant changes to ECU design. Thermal Energy Storage (TES) has been shown to be effective in load-leveling the daily cooling profile for fixed facilities, providing reductions in net energy consumption in some cases due to ‘free cooling’ [2], as well as reduced compressor cycling, more steady cooling, and reduced peak power requirements [3,4]. However, because of the compositional variability in cooled facilities in forward operating environments, implementing TES would require directly integrating the technology within mobile ECUs, a task which has received only cursory attention in the literature and would require optimization of overall size and weight in addition to reducing energy usage. Solid-liquid Phase Change Materials (PCMs) present one high-density TES option for cooling systems and environmental control [5,6], yet challenges remain in material selection, heat exchanger topology and integration strategy to maximize operational benefit. This SBIR program seeks to develop a PCM-based solution to enhance the performance of an existing ECU in the 9-18k BTUH range, addressing concerns of system energy density, material compatibility, and failure modes due to repeated thermal cycling. Offeror is expected to propose a phase change TES component that can be integrated into an existing ECU for the purpose of off-peak load leveling or demand reduction, with a target energy usage reduction of 5-10% over an average daily cycle, assuming no more than an 25F diurnal temperature variation. Unit should still be able to provide rated cooling capacity under worse case conditions in a deployed environment (design condition 125F ambient, 90F indoor dry bulb, 75F indoor wet bulb) for a period of at least 2 hours during daily peak demand period. Specification of PCM type, integration point (on refrigerant or air-side flow paths), storage temperature, and storage heat exchanger design are left up to the offeror, however those decisions and the associated impact on overall system size, weight and performance should be justified through thermodynamic analysis and system/component modeling.

Component: OSD
Firm: MicroLink Devices
Project Title: Increasing the Specific Power of Epitaxial Lift-Off Solar Cells for Cost-Effective, High-Efficiency, Flexible Photovoltaics
Award Amount: $ 1,000,000
Project Summary: Photovoltaics (solar cells) are an attractive technology to provide renewable energy sources for forward operating bases, man-portable power sources, and tactical applications. Solar arrays can provide base power greatly reducing the need for logistical fuels, continuous battery recharging for warfighters on the move, and integrated power sources for remote, autonomous systems, e.g. UAVs. To be effective, solar arrays

must be lightweight, flexible, and provide high power density. Flexible solar arrays based on thin film photovoltaics have been fielded for some military applications, but their usefulness has been limited by their low efficiency. Si panels have attained efficiencies as high as 22% but are made of glass and Al. Flexible amorphous Si or polycrystalline CIGS panels are less than 15% efficient. Higher efficiency, flexible solar cells have been demonstrated for space applications, but their cost has hindered terrestrial applications. New materials and manufacturing methodologies are needed to produce a solar cell that is lightweight, flexible, high efficiency, and affordable. The goal of this topic is to develop cost-effective, photovoltaic technologies that display high efficiencies in a flexible format.

Component: OSD
Firm: APECOR
Project Title: High Efficiency Electric Power Manager for Man-Portable Photovaltaic Systems **Award Amount:** $999,434
Project Summary: Renewable energy, specifically photovoltaic, is an attractive technology for man-portable power sources and tactical applications. However, to be effective as a system, it is necessary to have a power manager that can efficiently couple a small solar array (~20W) to a battery such as the BB2590. Power managers are already being fielded with PV sources, but their usefulness has been limited by the design of the power manager. The goal of this topic is to develop a cost-effective, lightweight power manager that displays high efficiencies for low power modules in a user-friendly format that can rapidly charge a BB2590. In addition, given the nature of Li-ion batteries, maximum use of solar input is achieved when multiple batteries are charged in parallel, so a power manager is sought that can charge multiple batteries simultaneously. Other capabilities that will benefit the system are scavenge mode, buck/ boost capability, high-speed maximum point tracking, reduced heat and IR signature, a wide operating temperature range, charging capability in low light (< 20% thermal efficiency and 100s of hours of operational life for baseline internal combustion (IC) engine-based propulsion systems within this size class. The main drawback is the lower system-level power density (~100 W/kg compared to ~1000 W/kg for a typical IC engine), which limits the applicability of such systems. For a typical SOFC-based system, the stack represents 30 - 40% of the system weight, assuming a stack power density of 200-300 W/kg. If the stack power density is increased to 500 – 1000 W/kg, this would facilitate a 2X-4X increase in the system level power density (i.e. 200 – 400 W/kg). This, when combined with the increased fuel efficiency, would enable an SOFC-based propulsion system to meet and/or exceed IC engine performance [1]. For example a 200 W/kg SOFC-based propulsion system at 30% efficiency would have comparable endurance to 1000 W/kg IC engine-based system at 20% efficiency, with the potential for increased reliability and operational lifetime. A number of SOFC concepts have been demonstrated at the button cell level, such as low-temperature (LT)-SOFCs [2], metal-supported SOFCs [3], or others; which have the potential to meet these power density goals. The main challenge

is exploring the feasibility of scaling up these novel concepts to the stack level while maintaining the same level of power density. For example, LT-SOFCs which have been demonstrated at ~2W/cm2 on the cell level are projected to produce a stack at ~3000W/kg. This projection, though, does not take into account the many issues which can lead to efficiency losses at the stack level, such as: interconnect resistance, interfacial gradients, fuel utilization, etc. The focus of this topic is to demonstrate the scalability of the novel cell-level technology to the larger area cell level (> 150 cm2 active area) in the Phase I and then to the stack level (500W – 3 kW) in the Phase II in order to determine the feasibility for integration into a complete SOFC power system. There is a particular interest in potential stack technologies which prove to be flexible to fuel reformate composition and tolerant to fuel impurities, such as sulfur content.

Component: OSD
Firm: Edge Case Research LLC
Project Title: Stress Testing Robustness to Exceptional Situations in Simulation Award **Amount:** $ 999,814
Project Summary: Recent advancements in sensor simulation tools [2] have improved our ability to model radar, lidar, camera, and GPS with software/hardware in the loop. Of course, our ability to model the physics of heavy trucks [3] is quite mature as well. To address the challenge of developing the STE, we will provide our autonomy algorithms as Government Furnished Equipment (GFE). The focus of this topic is: 1) to build an environment that mirrors actual test data to provide a departure point for Monte Carlo simulations. 2) research the failure modes for autonomy algorithms within the capabilities of current sensor models and 3) simulate the corner cases that would exercise these failure modes. This topic is not focused on improving physics-based simulation of heavy trucks or building better sensor models. Neither do we seek to develop new algorithms for autonomous behavior, but rather to leverage existing GFE autonomy algorithms to study the open research question of how we can test these algorithms in simulation, and certify that they are safe to the fullest extent possible within current simulation environments.

Component: OSD
Firm: Energid Technologies
Project Title: Autonomy Safety Testing Environment
Award Amount: $999,934
Project Summary: Recent advancements in sensor simulation tools [2] have improved our ability to model radar, lidar, camera, and GPS with software/hardware in the loop. Of course, our ability to model the physics of heavy trucks [3] is quite mature as well. To address the challenge of developing the STE, we will provide our autonomy algorithms as Government Furnished Equipment (GFE). The focus of this topic is: 1) to build an environment that mirrors actual test data to provide a departure point for Monte Carlo simulations. 2) research the failure modes

for autonomy algorithms within the capabilities of current sensor models and 3) simulate the corner cases that would exercise these failure modes. This topic is not focused on improving physics-based simulation of heavy trucks or building better sensor models. Neither do we seek to develop new algorithms for autonomous behavior, but rather to leverage existing GFE autonomy algorithms to study the open research question of how we can test these algorithms in simulation, and certify that they are safe to the fullest extent possible within current simulation environments.

Component: OSD
Firm: Robotic Research LLC
Project Title: Safe Autonomous Unmanned Vehicles for Installations SAUVI
Award Amount: $993,865
Project Summary: Distributed visual surveillance has a major role in the future of Unmanned Ground Vehicles (UGV's). Distributed visual surveillance refers to the use of cameras networked over a wide area to continually collect and process sensor data to recognize and classify objects in the environment. Analyzed data will inform unmanned decision-making and fleet management to optimize a transportation system. Sensors and camera systems mounted on UGVs will augment stationary surveillance hardware. An area of interest for this research is data fusion, co-operative multi-sensor tracking methods, and distributed processing. Also of interest is the reconciliation, classification, and prioritization of data; storage and accurate retrieval of archival references; and the selection of an appropriate action/response to the data. Although there are many potential sensors that can be used in distributed surveillance, in this topic we are focusing on visual (and perhaps infrared) imaging sensors whose cost, reliability, and availability makes transition to the field or commercialization much more likely. Communications bandwidth is and will remain a limited resource. Even with video compression technologies, there is insufficient bandwidth to upload all video and high-resolution still images from all network nodes. Artifacts due to heavy video compression would degrade most analysis applications and viewing all the data would overwhelm analysts. Local processing is therefore preferable to central processing to extract actionable information from the sensor data and to plan UGV position adjustments. An individual node can determine whether or not there has been a significant change in the situation that would warrant transmitting a package of sensor-level data. The scenario to be addressed in this topic is that a small fleet of 10-15 UGVs deployed at a CONUS installation in order to safely transport personnel, on-demand, from various point around one building one-third mile sharing pedestrian sidewalk, across an uncontrolled four-lane roadway, through a busy parking lot to another building on the installation. Vehicles will operate at speeds from 3mph (in mixed pedestrian traffic) up to potentially 25mph which is the limit for Neighborhood Electric Vehicles. Vehicles must recognize and respond appropriately to pedestrians, unconnected vehicles, and other environmental objects. Approximately 12 networked cameras fixed across along the route and around the test site will provide visual coverage of the area.

Sensors will have a priori visual background data and UGV location will be known (landmarks, GPS positioning, etc.) enabling temporal differential or background subtraction to locate objects. Capabilities desired for the UGV include ODOA, correct positioning and speed regulation with respect to moving and stationary objects, coordinated and optimized system-wide responses across the fleet, data collection and/or communications, and extracting actionable information from the sensor stream. Information of interest includes detection and behavior analysis of humans and vehicles, analysis of traffic patterns, and identification of suspicious activities or behaviors. The intended platform is an electric vehicle with size on the order of 500-600 Kg (roughly golf-cart sized). The platform is expected to manage its own energy usage and recharge itself, wirelessly, so energy efficient algorithms are of interest. UGV platform and payload development, including sensors and communications, are outside the scope of this topic.

Component: OSD
Firm: Pacific Science & Engineering
Project Title: Human/Autonomous-System Interaction and Collaboration
Award Amount: $989,978
Project Summary: Human-autonomous system interaction is frequently limited by lack of confidence and trust among the (combined) team. In order to have humans collaborate effectively with autonomous systems, improved interfaces and interaction techniques, and frameworks of interaction must be developed that allow for a common perception of the goals, constraints, resources, and other variables relevant to the team's overarching objective. Tools that allow for improved transparency into the machine's reasoning, human-machine interfaces that allow for more natural and flexible interaction and shared decision making, and information/decision frameworks that provide cognitively matched human-machine situational awareness would all support more effective and trusted human-machine teaming. Development of better measures of human trust or measures of the accuracy of shared human-machine perception would also facilitate improved teaming.

Component: DARPA
Firm: NanoTEM
Project Title: Electronic Component Fingerprinting to Determine Manufacturing Origin
Award Amount: $999,014
Project Summary: In the area of supply chain integrity improvement, the US defense and intelligence sectors anticipate multiple uses for the forensic capability to characterize an electronic component for the purpose of identifying the semiconductor fabrication facility.

Component: DARPA

Firm: Clearmark Systems, LLC
Project Title: Electronic Component Fingerprinting to Determine Manufacturing Origin
Award Amount: $1,499,985
Project Summary: ClearMark Systems has developed a sensitive and non-destructive inspection technology for identifying the point of origin of semiconductor chips. We capture the identifying information by analyzing markings on the silicon die or the chip package made by laser marking tools at the fabrication facility. Our Phase I effort has successfully distinguished markings that were made by a target tool versus similar challenge tools with very low false positive and false negative rates even when a challenge tool was controlled by an expert instructed to defeat our methodology. In our Phase II effort, the core technology will be expanded to improve the detectable feature resolution, increase the number of the feature-space dimensions used by the classifier, and improve computational efficiency. The entire process flow will be scripted and integrated in order to support automated application in the field. The outcome of the Phase II effort will be a comprehensive platform for the analysis of die serializations, package and wafer markings, and other identifiable markings on parts. The platform will enable in situ verification of the provenance of integrated circuits as well as more detailed comparisons against a database of “fingerprints” for the purpose of positively identifying specific tools of origin.

Component: DARPA
Firm: Ripple LLC
Project Title: EXTENSIBLE HERMETIC NEURAL INTERFACE MICROSYSTEMS
Award Amount: $998,540
Project Summary: The goal of this program is to develop a one-size-fits-many solution for implantable, wireless recording and stimulation with a variety of implantable electrode array types for neuroscience and neuroprosthesis research. The implants in this program will be enclosed in hermetic, ceramic packages with feed-throughs to accommodate up to 32 electrodes for each implant. The implants will be powered via inductive telemetry from an external transceiver placed directly over the implant, and data exchange will be accomplished through a combination of local inductive and transcutaneous infrared telemetry. The amplifier and telemetry will be programmable for sampling rates between 1 to 30 ksps at up to 16 bits resolution for supporting both low-frequency and higher frequency extracellular recordings. The local nature of these telemetry modes will allow multiple implants to be operated in proximity in the same subject. In parallel with this development, we will also complete a wearable data acquisition platform with programmable capabilities for real-time closed loop recording and stimulation. At the end of this program, the implants and external electronics will be sufficiently tested and qualified such that they can be approved for use with human studies for specific electrodes with minimal follow-on animal studies.

Component: DARPA
Firm: Akita Innovations LLC
Project Title: Next-Generation Voltage Sensitive Dyes for Cell Bioelectricity Measurements **Award Amount:** $1,510,000
Project Summary: Tissue differentiation, repair, and regeneration as well as the basic operation of excitable cells depends on cell membrane potential. The ability to measure these potentials for large numbers of cells and without invasive electrodes depends on the continued development of optical probes: voltage-sensitive dyes. Akita and its partners are working on a new class of such dyes which will provide higher sensitivity and voltage resolution as well as the ability to be targeted to particular types of cells with fast response. Our dyes are designed to offer good solubility, long emission wavelength, and resistance to photobleaching that can affect other types of dyes.

Component: DARPA
Firm: Photon Spot, Inc.
Project Title: High Efficiency Superconducting Nanowire Single-Photon Detectors
Award Amount: $1,499,804
Project Summary: Photon Spot will demonstrate a compact superconducting nanowire detector system that simultaneously achieves near unity system detection efficiency, sub-Hz system dark count rate, and >1 GHz count rates.

Component: DARPA
Firm: Commercial Computer Systems, LLC
Project Title: A System Programming Method
Award Amount: $498,208
Project Summary: For computer based systems where time is important, a methodology is proposed which separates applications from architecture. A System is represented graphically in Blueprints, and textually in Formal Models expressed in the Real-time Executable Architecture Language (REAL). The system application and architecture are evolved to work in harmony using the SIMPLEX temporal performance simulation to assess the consequences of each decision.

Component: DARPA
Firm: biodesigns Inc.
Project Title: Adaptive Diagnosti Tooling for Customized Upper Limb Prosthetic Socket Fitment Award Amount: $1,499,972

Project Summary: Dexterous arms, despite the promise they bring of significant enhancements to current technology, are subordinate to the socket that interfaces with the user. The numerous and distinct challenges present at this level of amputation together with the dearth of clinicians with upper limb expertise capable of creating a functionally superior socket present a formidable threat to user acceptance and the ability to maximize the performance of the advanced arm of the future. In response to these challenges, we propose the creation of a Sensorized Imager Tool (SIT) that will guide the clinician, expert or novice, in the proper data acquisition, creation and fitment of a functionally superior interface capable of meeting and exceeding the demands of both the dexterous arm and its operator. The SIT will also be paired with a Sensorized Socket Tool (SST) paving the way for the world's first smart interface capable of capturing and controlling the underlying skeletal structure of the target limb. Through a series of adaptive, reactive and predictive responses to internal and external stimuli the interface will maintain absolute comfort and safety while concurrently providing maximum performance ranging from casual civilian use to the extreme demands of today's and tomorrow's warfighter.

Component: DARPA
Firm: Modular Bionics Inc.
Project Title: Roaming Animal Microsystems (RoAM)
Award Amount: $999,854
Project Summary: The goal of this proposal is to develop an implant capable of wirelessly streaming electrophysiological signals and controlling stimulation pulses from a wide variety of anatomical targets for the purposes of neuroscience research. Such an implant does not exist and would be of great benefit to the neuroscience community. There is a well-recognized need among neuroscientists to monitor a large number of neural signals from freely behaving animals from an implanted system. There is a similar need for an implantable, high channel count neural stimulator. The BRAIN initiative has intensified this need as no commercial solution exists for an implanted device capable of streaming a large number of neural signals or controlling a large number of stimulation channels.

Component: DARPA
Firm: Triangle BioSystems, Inc.
Project Title: EXTENSIBLE, WIRELESS, AND IMPLANTABLE NEURAL-INTERFACE MICROSYSTEMS
Award Amount: $1,499,972
Project Summary: Existing high-channel-count interfaces used to capture neural information from and to stimulate neural activity in tissues rely on transcutaneous connections to convey both information and power. These transcutaneous connections introduce a number of significant problems: limit patient comfort/mobility, increase infection risk, and significantly reduce the long-term system reliability. In this Phase II SBIR we will

design, fabricate, evaluate, and begin the commercialization of a novel, extensible, wireless, hermetic, and implantable neural interface microsystems, capable of both multichannel recording and stimulation of CNS, PNS, and muscle tissues. The comprehensive system we propose to fabricate will leverage extensive prior work (DOD SBIR Phase I supported) by Triangle BioSystems International, Inc. (TBSI), to successfully develop, manufacture and rapidly commercialize high-channel-count wireless neural telemetry products. Our objective is to define a system-level design approach to yield a manufacturable and commercializable general-purpose wireless neural telemetry system that will be broadly applicable to both the neuroscience and neuroengineering research and development communities. Our implantable bi-direction system will have a scalable architecture capable of at least 64 channels of recording and more than 16 channels of stimulation. To maximize likelihood of approval from the FDA, FCC, and IEC, we will create our prototypes to be informed by relevant standards and guidance documents.

Component: DARPA
Firm: Commercial Computer Systems, LLC
Project Title: A System Programming Method
Award Amount: $498,208
Project Summary: For computer based systems where time is important, a methodology is proposed which separates applications from architecture. A System is represented graphically in Blueprints, and textually in Formal Models expressed in the Real-time Executable Architecture Language (REAL). The system application and architecture are evolved to work in harmony using the SIMPLEX temporal performance simulation to assess the consequences of each decision.

Component: DARPA
Firm: Sarda Technologies, Inc.
Project Title: High Performance, Integrated Transistors for On-Chip Power Supplies
Award Amount: $999,926
Project Summary: This project aggregates, adapts and leverages the optimum technology for each function in a heterogeneously integrated power stage (HIPS) for package-integrated voltage regulators (PIVRs): • Gallium arsenide (GaAs) die - monolithically integrate multiple lateral field effect transistors (FETs) using a high-volume foundry. Sarda’s technology reduces the GaAs cost by >80% by reducing the die size and enhancing the yield. • CMOS die - monolithically integrates the FET drivers, controllers and protection, using a high-volume foundry. • 3D Power Packaging - integrates the die and passive components in a compact QFN package utilizing high-volume 3D packaging technology.

Component: DARPA
Firm: SynPloid Biotek LLC
Project Title: Advanced Tools for Mammalian Genome Engineering
Award Amount: $999,350
Project Summary: Recent advances in mammalian artificial chromosome design and engineering offer an alternative to existing methodologies for cellular bioengineering and address unmet needs to bioengineer more complex functionalities into human cells for subsequent commercialization. In this ST13B-001 application we propose to demonstrate utility of a novel chromosome-based gene delivery vehicle that is amenable to large genetic payloads while avoiding insertional mutagenesis and maintaining stable, long-term, gene expression. A cornerstone to our proposal is the utilization of a distinctive mammalian artificial chromosome technology termed Artificial Chromosome Expression System (ACE System), an autonomous chromosome-based “circuit-board” designed to contain approximately 70 site-specific recombination acceptor sites that can carry single or multiple copies of genes or DNA elements of interest. In Phase I of this solicitation we delivered a 144Kbp BAC containing the MCT1 genomic locus onto the platform ACE that had previously been loaded with a 168Kbp BAC, resulting in 312Kbp of total DNA added. In addition to demonstrating the specificity of integration we confirmed the structural stability of the genomic DNAs. In Phase II we will expand this disruptive technology by engineering additional robust and complex functionalities into the ACE system toward the goal of cell-based therapeutics.

Component: DARPA
Firm: Bashpole Software, Inc.
Project Title: Mashalator SSP2
Award Amount: $1,461,858
Project Summary: The proposed effort will expand on the previous effort’s data mashing technology development to enable it to handle scenarios that are simultaneously more complicated and more dependent on high accuracy. This project will fulfill the solicitation’s Phase II goal, “Develop a prototype that demonstrates the efficacy of DATALATOR technology based on Phase I results, data, and analysis. Evaluate the performance of the prototype through experimentation on operationally realistic data.”

Component: DHP
Firm: Design Interactive, Inc.
Project Title: Discrete Event Simulation and Optimization Approach for Balancing Usability and Security for Medical Devices in an Integrated Clinical Environment
Award Amount: $149,931

Project Summary: Integrated clinical environments (ICEs) include medical devices and systems that process, store, and share sensitive data over networks. This requires that security concerns and data privacy be addressed. However, the design of such controls can conflict with the usability of the medical devices, especially in high pressure, time-sensitive conditions such as acute clinical and remote care settings. For multiple team members, patients, devices, and locations, it is difficult to gauge how different configurations of security controls impact the safety, usability, and workflow of the system. There is a great need for computerized workflow models that represent complex clinical scenarios which may be used to analyze the impact of security controls on medical device systems while balancing usability concerns and minimizing impact on clinical workflow. Design Interactive, Inc. (DI) proposes to develop the Security and Usability Model for Devices in an Integrated Clinical Environment (SUM-DEVICE) System, which allows interactive exploration of performance of a simulation model for a clinical workflow scenario using multiple medical devices with an array of possible security mechanisms that can be selected. Performance of the simulation is then measured using a set of metrics to evaluate security, usability, and workflow in each run of the simulation.

Component: DHP

Firm: Neuroctix Corp.

Project Title: Novel Intraocular Visualization Tools

Award Amount: $146,976

Project Summary: A surgical insert for an 18-gauge needle has been developed incorporating two working channels, one for forward-looking 3D imaging, and a second working channel for a therapeutic embodiment (cutting, coagulation, precision injection of drugs, etc). We propose here an approach to scale down the insert to allow it to be incorporated in smaller gauge (20, 22) needles with significant size, weight and power requirement reductions suitable for precision ophthalmic surgery, but with no loss of imaging speed, resolution or range.

Component: DHP

Firm: How Many Engineers

Project Title: Methodologies and Tools for Securing Medical Device Systems in Integrated Clinical Environment (ICE)

Award Amount: $149,953

Project Summary: Develop an interoperable specification language for the security properties of an ICE supervisor, network controller, logger, and supervisor app components for an interoperable MAP/ICE system architecture that is PNP interoperable, both human and machine readable, defined by a clearly delineated scope and purpose, suitable for both human and automated analysis at assembly time and run time, extensible, and mappable to existing functional and clinical interoperability specifications. Develop a toolset for analyzing and reasoning about the security properties of those ICE components and the assembled ICE system at both

connection time and during run time. Adapt the interoperable security specification language to be compatible with and extend existing functional and clinical interoperability solutions and standards. Analyze the failure modes of the MAP/ICE components, and ICE system utilizing the security specification language within the defined security specification language scope.

Component: DHP
Firm: Vecna Technologies, Inc.
Project Title: Virtual Medical Concierge Application
Award Amount: $150,000
Project Summary: Large medical centers can overwhelm patients - for example, Walter Reed National Military Medical Center covers over 2.4 million square feet of clinical space - yet the primary objective for these facilities is to provide patient satisfaction with the healthcare services. A Virtual Concierge application is being proposed to help guide the patients throughout their entire visit at the medical facility. The proposed effort will provide an Application Program Interface (API) platform to interact with the DOD scheduling system, along with a Virtual Concierge mobile app to utilize the appointment information to provide a customized itinerary for the patient. Interfaces will also be established to interact with commercially available technologies that can support Virtual Concierge services, such as digital signage, indoor positioning, and service robots. The Convenient Care Model will be used for designing and developing the application to achieve meaningful and sustainable success.

Component: DHP
Firm: Knowledge Based Systems, Inc.
Project Title: Data Integration and Predictive Analysis System (IPAS)
Award Amount: $150,000
Project Summary: KBSI proposes to design and develop a Data Integration and Predictive Analysis System (IPAS) for the prediction of incidents of human infectious diseases. IPAS will utilize innovative collection of data from open data sources, veterinary and medical professionals, and public observations, together with data cleaning, harmonization, spatiotemporal pattern extraction, factor analysis, and predictive models to provide comprehensive disease incidence prediction. The project will collect and integrate a comprehensive dataset of previous disease occurrences and potential influencing factors like environmental conditions, regional health status and practices, demographics, ethnicity and cultural practices, veterinary and zoonotic indicators, and vector prevalence. Natural language processing (NLP) will be used to extract disease, syndromic, and zoonotic details from news feeds, public health reports, and medical publications. A smartphone app will be used to collect data from situated public, veterinary, and health officials on veterinary, zoonotic, and human signs and symptoms, and on the prevalence of vectors. Machine learning and predictive-analytics-based models will be developed to

predict the probability of occurrence of disease for specific geographical locations and times. Phase I will focus on a select CDC Category A disease.

Component: DHP
Firm: KCF Technologies, Inc.
Project Title: Advanced Sensor Integration for Prosthetic Socket Monitoring
Award Amount: $963,244
Project Summary: The objective of the Phase II project is to develop a Residual Limb Health Monitoring Platform based on the Phase I findings and will integrate a sensor equipped smart socket liner, smart socket with radio transceiver and power source, and health monitoring software. Significantly, the software and hardware are open interface for new, 3rd party sensors, data transfer protocols, and prosthetic components. This Phase II development project will follow a traditional design effort involving Concept Design, Detailed Design and Fabrication, and Test and Validation. The Concept Design stage primarily involves defining system level requirements and designing and prototyping subsystems. The Detailed Design and Fabrication phase will involve revising the design concepts, performing detailed design, and building advanced prototypes that can be used for field testing. The final Test and Validation effort will involve updating the test model design, performing bench testing of components in a representative environment, and finally conducting prototype testing in a simulated operational environment with clinicians.

Component: DHP
Firm: Widder Brothers, Inc.
Project Title: Long-lasting Disposable Insecticidal/Repellent Fabric Barrier for Personal or Area Protection Against Biting Arthropods
Award Amount: $972,519
Project Summary: We propose to build a commercially viable spatial repellency device that requires no outside energy for activation (fire, electricity or air flow). Currently, no other indoor or outdoor spatial device exists that meets these criteria and no other device offers prolonged protection without refilling or replacing the device. Our development work relied heavily on using proven production techniques to treat the PIK substrates enabling an easy transition to production-rate environment and the focus of the Phase II work involves optimizing release rates of the active ingredient and surface area of the PIK. Additional research has been conducted on PIK product design and packaging which would support our goal of a lightweight, disposable and easy to deploy device with low environmental fate risk and low to no dermal contact risk. This early development work on the PIK also lends itself to adoption for related products for both indoor and outdoor use including larger spatial devices for prolonged

outdoor protection and personal devices such as treated patches or other personal items for use in vector-dense areas.

Component: DHP
Firm: Intelligent Automation, Inc.
Project Title: TPM: A Voice-based Tele-PTSD Monitor
Award Amount: $1,000,000
Project Summary: In the initial SBIR Phase II, Intelligent Automation, Inc. (IAI) developed a voice-based Tele-PTSD Monitor (TPM) system to remotely screen, monitor, and provide assistance to clinicians in assessing a PTSD patient's condition. ListEn is the "brain" of TPM system. It processes the voice data, extracts different types of salient features, and computes PTSD scores based on state-of-art machine learning algorithms. The ListEn only relies on voice to perform remote PTSD monitoring and does not require costly video conferencing facility or cumbersome physiological sensors Here IAI proposes a second SBIR Phase II (Phase II-2) research effort to further improve the voice-based PTSD assessment technique by incorporating the latest machine learning algorithms and conduct a large-scale validation with the voice data from 200 test subjects. The voice data will be collected by researchers from the National Center for Veterans from over 200 participants at Fort Carson, CO, 100 diagnosed with PTSD and 100 control participants, all male with mean age in the mid-20s, the group with highest risk to PTSD. The outcome of this Phase II will be fully functional ListEn PTSD scoring engine and TPM prototype mobile app for military and civilian applications.

Component: DHP
Firm: PAXVAX, INC
Project Title: Modernized Production of Enteric Coated Live, Oral Adenovirus Vaccine
Award Amount: $1,000,000
Project Summary: Adenoviruses are a frequent cause of epidemic acute respiratory disease (ARD) in military recruit training centers and pose a significant threat to military readiness, especially during times of large mobilization. There are no FDA-licensed treatment options available for adenovirus infections. Under the SBIR phase I, PaxVax successfully re-developed research-grade Ad4 and Ad7 capsule vaccines with comparable potency to the Teva Ad4 and Ad7 Tablet vaccines using modernized platform technologies, including a high-yield continuous cell line, serum-free medium, single-use bioreactor and purification technologies, new thermostable formulations and aqueous enteric-coating. During the SBIR Phase II, PaxVax will cGMP manufacture clinical Ad4/Ad7 vaccines with processes and assays developed under the SBIR I. PaxVax will produce Ad4/Ad7 cGMP master viral seeds (MVS) with plaque-purified and amplified pre-MVS, bulk drug substances (BDS), and final drug products (FDP), and subsequently release these products for clinical trials. The produced Ad4/Ad7 FDP will

also be placed on a stability program as required to support the trials. A small clinical trial will be conducted to evaluate the safety and immunogenicity of a single dose of the PaxVax Ad4/Ad7 vaccines. A successful clinical trial will in turn advance the production processes to a commercial production stage.

Component: DHP
Firm: CFD Research Corporation
Project Title: A Rapid and High-Throughput Microfluidic Stem Cell Analyzer
Award Amount: $999,993
Project Summary: Current methods for stem cell isolation are time-consuming, costly, and labor-intensive, and ill-suited for point of care applications. To overcome these limitations, we propose to develop and demonstrate a high-throughput, non-invasive, microfluidic stem cell analyzer to enable a rapid isolation of high-quality stem cell products from clinically relevant samples. Our technology enables significant improvements in processing time, automation, cell integrity, and logistical burden and cost, and opens a new possibility for intraoperative therapeutics. In the initial effort, key technology components were successfully developed. Device design, microfabrication, and experimental test were all undertaken to demonstrate microfluidic cell sorting and impedance characterization of stem cell differentiation, which markedly enhances TRL of the technology. This proposed effort will focus along two directions. First, a novel cell sorter will be developed to address challenges associated with clinical samples, such as large volume, high cell contents, target cell rarity, etc. Design optimization, fabrication refinement, and experimental characterization will be carried out to establish feasibility of the non-culture based stem cell isolation. Second, the sorter will be integrated with COTS component technologies for automated operation to improve GMP-readiness of the technology. The functionality of stem cell isolation will be extensively demonstrated using various preclinical samples, e.g., bone marrow, adipose, skin etc. A multi-disciplinary team with experience in all aspects of the proposed effort including microfluidics, stem cell bioengineering, regenerative medicine, and systems engineering has been assembled to ensure successful completion of project milestones.
Component: DLA
Firm: Retriev Technologies, Inc.
Project Title: Green Lower Cost Batteries
Award Amount: $99,876
Project Summary: This program will recover and regenerate intact cathode and anode powders from 18650 cells and other lithium-ion batteries (LIB) currently recovered for metal value only, and use these recycled and regenerated materials to domestically manufacture LIB's in a cost competitive manner. Manufacturing costs of Asian 18650 LIB cells is approximately $0.26 per cell lower than identical cells made in the US, a difficult barrier to overcome. The cathode material is the most expensive raw material in LIB's, contributing $0.52 per cell. To

lower costs of LIB cathode materials to US LIB manufacturers, LithChem Energy (LCE) proposes recovering and regenerating intact cathode material, anode carbon and metals from the current market mix of used LIB's for direct use back into manufacturing new LIB's. LCE has a patented low cost process for separating and regenerating mixed intact cathode materials from used LIB and LIB manufacturing scrap. The recovered materials will provide US LIB manufacturers low cost LIB raw materials, saving approximately $0.34 per 18650 cell and promote sustainability to the US LIB materials supply chain. LCE will produce cells for DOD form factor batteries as well as consumer electronics products such as cell phone and e-cigarettes.

Component: DLA
Firm: Physical Sciences Inc.
Project Title: Development of Advanced Battery Manufacturing Techniques
Award Amount: $99,975
Project Summary: Physical Sciences Inc. together with EaglePicher Technologies will demonstrate that PSI's proprietary coating techniques can be employed to reduce the cost of producing lithium ion cells while improving the energy density and safety. Testing will clearly demonstrate the ability to increase the active material content and electrode density, provide insitu short circuit protection, and reduce both the solvent required during electrode production and the electrolyte in each cell. The result will be a safer, more energy dense cell that costs less to produce. During Phase I, the team will demonstrate a 50% reduction in the amount of solvent required to produce the cathode electrode. Increased abuse tolerance will be highlighted by demonstrating a 50% reduction in the short-circuit current and a reduction in the required amount of electrolyte in a given cell. Coin and pouch cell testing will highlight the ability to achieve the targeted rate performance while achieving increased energy densities. The testing during the base and option efforts will clearly show the ability to use the PSI coated materials to produce a cheaper, safer, more energy dense cell for DLA applications. Phase II will focus on building this cell and qualifying its performance and the manufacturing cost gains.

Component: DLA
Firm: CAMX Power LLC
Project Title: Logistically Robust, Long Life, High Power Rechargeable Battery
Award Amount: $99,933
Project Summary: CAMX Power proposes to develop a high power, long life lithium-ion (Liion) vehicle battery that can be completely de-energized for logistical transportation and storage purposes, giving it exceptional shelf life and making it intrinsically safe under conditions of relaxed environmental controls and with no or minimal state-of-health monitoring. This novel battery, based on CAMX Power's proprietary CAM-7 cathode material and a lithium titanate anode material, will provide the extended temperature range performance, energy density and

cycle life needed to meet the increasingly demanding requirements placed on vehicle batteries by expanded missions such as Silent Watch. While alleviating the logistical and safety concerns that are impediments to implementing high energy, long life Li-ion technology in military vehicles.

Component: DLA
Firm: CAMX Power LLC
Project Title: Reduced Manufacturing Cost for Li-ion Batteries
Award Amount: $99,963
Project Summary: Lithium-ion batteries are being increasingly deployed in DOD applications as the result of their very high energy and power densities, but their manufacturing costs are high because of relatively long production timescales, The primary factor limiting throughput in Li-ion cell production is the long time required for the “formation” and aging sequence in which cells are cycled to render the cell operational and are then aged for a period of days or weeks in an effort to screen for the presence of internal short circuits. CAMX Power has developed a safety technology for detection of nascent internal short circuits in batteries, and proposes to adapt that technology to the lithium-ion cell manufacturing environment so as to reduce formation and aging time and thus increase production throughput. Further, we are proposing to improve the effectiveness of manufacturing quality control procedures to screen for internal short circuits.

Component: DLA
Firm: Xerion Advanced Battery Corporation
Project Title: Advanced Battery Manufacturing Technologies
Award Amount: $99,920
Project Summary: Xerion Advanced Battery Corp (XABC) proposes Advanced Battery Manufacturing Techniques for High Performance, Low Cost Lithium Ion Batteries. XABC has developed a 3D battery electrode called StructurePore™ that allows for rapid ion and electron transport, enabling 5-minute charge times at 280Wh/kg on a positive + negative electrode basis. StructurePore™ batteries utilize a novel manufacturing method, electroplating, which typically is not used in battery manufacturing. Electroplating allows usage of material precursors that are inherently cheaper than refined ceramic powders. These precursors may be cheaper (10-30%) or significantly cheaper (1x-5x) depending on purity. A 53% reduction in raw material cost has been shown to reduce total cost ($/kWh) by 30% at large volume. Furthermore, electroplating reduces process complexity; resulting in decreased reliance on milling and sintering, thus further reducing costs. Due to their ability to handle high power, StructurePore™ batteries have inherently low internal resistance, which decreases thermal buildup and stress under normal and even extreme conditions. A 3D conductive current collector, built into all

StructurePore™ batteries, helps to dissipate heat without the need for heat sinks or extensive modification. All of this results in a product that is inherently safer than a traditional 2D lithium ion battery.

Component: DLA
Firm: ADA Technologies, Inc.
Project Title: High Speed, Automated Lithium Ion Laser Electrode Cutter
Award Amount: $99,999
Project Summary: Manufacturing technologies for Li-ion batteries have not kept pace with the rapid innovation of high-energy Li-ion chemistries, inhibiting battery performance and compromising safety. Recent studies have shown that one of the major reasons for Li-ion battery failure (self-discharge, catastrophic failure etc.) can be attributed to manufacturing defects caused by mechanical (metal) die cutters, which leave metal shards between the electrodes and separators. In addition, uneven, low tolerance edges, burrs, debris, and low reliability lead to cell failure and less than optimal performance. Finally, dies represent “life-time buy” systems, leading to inflexible manufacturing and serious impediments to agile design modifications. To address this need, ADA Technologies, Inc., in partnership with Laser Mark’s Company, a laser systems integrator, proposes the design of a low-cost, automated, high-speed/high-throughput electrode pulsed laser cutter capable of producing high quality Li-ion electrodes in an additive manufacturing environment. Through the implementation of the latest in laser technology and scanning systems coupled with innovative design and automation, we envision the development of a low-cost, flexible, high quality laser cutter capable of eliminating sharp edges, burrs, and debris to enable safe operation, minimizing the chances of cell failure and thermal runaway.

Component: DLA
Firm: K2 Energy Solutions, Inc.
Project Title: Advanced Battery Manufacturing Technologies
Award Amount: $99,008
Project Summary: K2 Energy Solutions, a manufacturer of lithium ion batteries headquartered in Henderson, NV, will develop a cell manufacturing process that eliminates the use of VOC’s. The elimination of VOC’s will result in substantial reductions in cell raw materials costs as well as substantial reductions in facility construction and operational costs. The successful conclusion of this project will enable the VOC-free manufacturing of lithium ion batteries, which would result in a substantial cost reduction over current manufacturing techniques.

Component: DTRA
Firm: Multibeam Corp., Santa Clara, CA
Project Title: Low-Energy e-Beam Direct Write for Trusted IC Production

Award Amount: $2,000,000

Project Summary: Multibeam Corporation (Multibeam) has developed electron-beam directwrite (EBDW) technology that writes IC patterns directly on wafer without masks. Operating at low energy, it is well suited for fabricating Rad-Hard ICs. Multibeam's proprietary technology can drastically reduce production cost of advanced Trusted microchips. Working with 1D design layout from Tela Innovations (Tela), Multibeam EBDW significantly improves anticounterfeiting and supply chain traceability to meet DOD and OGA demands for anti-tamper and Trusted microelectronics for ROICs, FPGAs, and Classified ICs.

Component: MDA

Firm Name: X-wave Innovations, Inc.

Project Title: Innovative Methods for Characterizing Manufacturing Defects

Award Amount: $992,608

Project Summary: To meet the MDA's need for innovative nondestructive testing (NDT) technologies for improving the manufacturing processes, yield and quality of a wide range of the weapon system components, X-wave Innovations, Inc. (XII), along with Prof. Xiaoyan Han from Wayne State University, is developing an innovative Portable Thermosonic Imaging System (PTIS) for rapid, full-field NDT of micro-fractures and voids in the weapon system components. The proposed approach is based on the XII-developed Thermosonic NDT technology and Prof. Han's significant work in this field. The proposed PTIS combines a portable Thermosonic imaging device and advanced signal processing algorithms for intelligent detection of micro fractures and voids in THAAD components made of different shapes, sizes and materials. In the Phase I program, XII successfully developed a PTIM prototype and demonstrated the feasibility of the proposed approach. In the Phase II program, XII will refine the PTIM prototype with improved hardware and software. For the Phase III program, XII will focus on transitioning the developed technology to a wide range of military and commercial applications. The proposed PTIS system should have many market applications in different industries such as air and space vehicles, power generators, and advanced new material research. Detection of micro defects is invaluable for gaining understanding of structural and material response, damage initiation, progressive damage, and ultimately limit state attainment in many important material systems. The proposed research provides a great support for validation and optimization of mechanical components design, post-manufacturing quality assurance, as well as for improvement of THAAD system reliability. Such a PTIS system will benefit the enhancement of the lifetime and durability and the reduction of failure risk of a product.

Component: MDA

Firm Name: Micro-Precision Technologies

Project Title: Ruggedized Ceramic Circuit Card Assemblies

Award Amount: $1,000,000

Project Summary: Micro-Precision Technologies (MPT) will build, test, and deliver to MDA high-performance ceramic circuit card assemblies for the SM-3 Throttling Divert and Attitude Control System (TDACS). Based on our commercially proven, QML-38534–listed technology for ceramic-based hybrid microcircuit and multi-chip module manufacturing, we will meet the MDA requirements for increased solder toughness, reduced footprint and weight, and survivability to temperature and humidity cycling, vibration, and shock. The ceramic technology developed in this program is essential for reliable operation in physically challenging and environmentally adverse conditions. Military applications include communications systems, control systems, and electrical equipment in fixed wing and rotary aircraft, missiles, naval ships and submarines, and ground support vehicles such as tanks and personnel carriers. Commercial applications include satellite-borne electronics, space vehicles and systems, commercial aircraft, power plants and nuclear reactors, and oil, gas, and geothermal exploration.

Component: MDA

Firm: Chip Design Systems

Project Title: Gallium Arsenide (GaAs) - Superlattice Light Emitting Diode Arrays

Award Amount: $1,000,000

Project Summary: We propose to monolithically integrate an IRLED array on the backside of a GaAs substrate whose front side contains an array of driver circuits. We will develop smaller GaAs substrate via technology to enable smaller pixel pitch and realize a large-scale GaAsSLEDS RIIC. Our team consists of experts in IRLED fabrication, read-in integrated circuit design, GaAs IC fabrication, system design, and thermal modeling. Infrared LED (IRLED) arrays represent a potentially game changing technology for presenting infrared images in sensor ground test environments offering high frame rate and high temperature simulation, while achieving superior manufacturing yield and uniformity than competing resistor array technology. The proposed work offers a significant opportunity for achieving near-term breakthrough results in making effective IRLED scene projectors by developing areas of IRLED technology that have not been previously addressed.

Component: Navy

Firm Name: TRITON SYSTEMS, INC.

Project Title: Life improvement of Plain Airframe Bearings by Preventing Contamination **Award Amount:** $749,943

Project Summary: Plain, self-lubricating spherical bearings operating in high levels of airborne abrasive contaminant particle environments, such as desert regions, are subject to accelerated wear of their PTFE (Polytetrafluoroethylene) liner systems. Accelerated bearing wear has been observed in fielded aircraft and leads to increased maintenance costs, Flight Safety Risk and reduced operational availability. The Navy has a need to

protect bearings from contamination in order to increase bearing life and relieve maintenance burdens. Triton Systems proposes to develop a prototype device to improve plain bearing performance in a contaminated environment. Triton will design and fabricate and test prototypes of the device.

Component: Navy
Firm Name: Applied Thin Films, Inc.
Project Title: Ceramic Matrix Composites for Advanced Tactical Missile Radomes
Award Amount: $998,656
Project Summary: Advanced missile radomes require robust high temperature materials for high speed flight. Current advanced radome materials are limited by thermal, electrical, and impact performance. ATFI has developed an oxide ceramic matrix composite (CMC) which has demonstrated required electrical, thermal and structural performance. This proposal will focus on improved impact performance, as well as incorporating lower cost fiber reinforcements to reduce cost.

Component: Navy
Firm Name: Mainstream Engineering Corporation
Project Title: Advanced and Additive Materials Manufacturing for Energy Applications using Superconducting Electron Beam Technology
Award Amount: $863,318
Project Summary: High power, superconducting electron linear accelerators represent a new method of producing highly focused electron beams (Ebeams). These instruments have exciting applications in the area of free electron lasers and directed energy weapons, but are costly and currently only useful in small, highly-specialized markets. Using these high energy Ebeams for materials processing opens up additional markets for these instruments and in turn lower their manufacturing costs. In Phase I, Mainstream identified several materials processes that could be uniquely improved by the use of Ebeam treatment. In an initial Phase II, a new type of superconducting electron linear accelerator was procured in order to demonstrate the economical production of diamond copper composite heat spreaders. This subsequent Phase II will enable this Ebeam to also be demonstrated in the fabrication of copper indium gallium selenide nanocrystal films for advanced solar cells. Additionally, this Phase II will facilitate the commissioning of an advanced manufacturing facility at Mainstream, with the Ebeam as the centerpiece. The resulting Ebeam facility will establish a marketplace for these highly specialized Ebeams as well as produce several exciting new materials at the pilot-scale with both military and commercial applications.