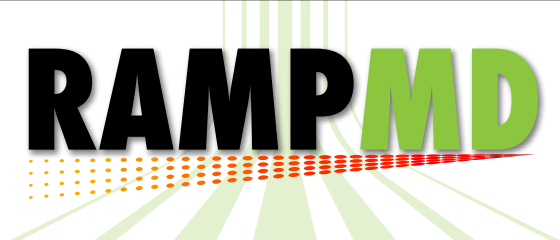


YEAR ONE

Annual Report of the
Regional Additive
Manufacturing Partnership
of Maryland

2015

RAMPMD



Year One Highlights

RAMP MD got off to a strong start with an active and successful Year One, thanks to the support of its Board of Directors, volunteers, partners, Harford and Cecil County Offices of Economic Development, the Economic Alliance of Greater Baltimore, and Maryland Department of Business and Economic Development.



JUNE 2014

» Former Governor Martin O'Malley signed into law SB 889 establishing the Northeastern Maryland Additive Manufacturing Innovation Authority (renamed RAMP MD) with a mission to support manufacturing and further additive manufacturing technology in Maryland. The Authority was formalized on June 22, 2014 with approval of the by-laws of the non-profit, IRS Code 501 (c)(3).



JULY 2014

» The 25 members of RAMP MD's Board of Directors held its first Board meeting and elected its Executive Board: David Wheatley, chairman; Harry MacArthur, vice chairman; Chris Cosgrove, Treasurer; and Jill McClune, secretary. Rick Decker was appointed executive director.

» Also in July the technical director of the US Army Edgewood Chemical Biological Center (ECBC), and the executive director of RAMP MD signed a Cooperative Research and Development Agreement as the first significant step in making the Authority a productive reality. This overarching agreement accommodates partnerships with numerous private entities.



AUGUST 2014

» The board submitted per law its business plan to Maryland's Secretary of Business and Economic Development. The document provided an overview of RAMP MD, its market position, near-term operating plan and quantitative goals. RAMP MD received start-up funding from DBED, Harford County, and Cecil County.



SEPTEMBER 2014 – APRIL 2015

» RAMP MD established four working committees: Finance, Grants and Contracts, Marketing and Workforce Training and Education and appointed committee chairs.

» RAMP MD executed 10 separate Joint Work Statements with both large and small firms.

» RAMP MD spread the word about additive manufacturing at numerous local and state government, educational, business and manufacturing promotional events

» RAMP MD supported the local school system and academic community by identifying and developing additive manufacturing occupational pathways. It also helped the region's workforce development organizations identify training, retraining, continuing education, and certification requirements for a viable workforce.



MAY - JUNE 2015

» RAMP MD held its first symposium, entitled "Additive Manufacturing: It's more than 3D Printing" at the new Towson University in Northeastern Maryland (TUNE) building. The event attracted over 150 leaders from industry, academia, government, and education. Participants explored a variety of topics related to additive manufacturing, such as bio-printing, education and workforce perspectives, materials science, choosing technologies, and much more.

» RAMP MD launched its web site at rampmd.org

» RAMP MD executed two additional Joint Work Statements with Maryland firms.



RAMP MD: Ushering in a new industrial age



We are just beginning to recognize the tremendous impact additive manufacturing will have on our community. Not only will the capability bring new high-tech jobs to our region for people of all skill levels, it has the potential

to change the way we live, work, and play. It has been called the transformative technology of the 21st Century and Maryland is at its leading edge. But the additive manufacturing industry is still in its infancy, and as such the equipment and expertise are still beyond the reach of most businesses.

That's why an organization like Regional Additive Manufacturing Partnership of Maryland (RAMP MD) is so important to the growth of this industry. RAMP MD provides companies access to equipment and capabilities through public-private partnerships. Partners have access to the tremendous resources — particularly facilities and expertise — of Edgewood Chemical Biological Center, which has some of

the most advanced capabilities in the nation as well as 25 years experience creating solutions using additive manufacturing technology.

In its first year, RAMP MD established 12 partnerships with firms doing business in Maryland and we are looking forward to more than doubling that number in our second year. RAMP MD is also pleased to work with educators and policy makers — raising awareness about this new industry and the workforce opportunities associated with it.

Just like Ford's assembly line ushered in the concept of mass production, additive manufacturing offers the potential for mass customization, and brings dramatic reductions in the time and cost to develop a new product. We are indeed entering a new industrial age, and we welcome you to join with RAMP MD as we explore its frontiers.

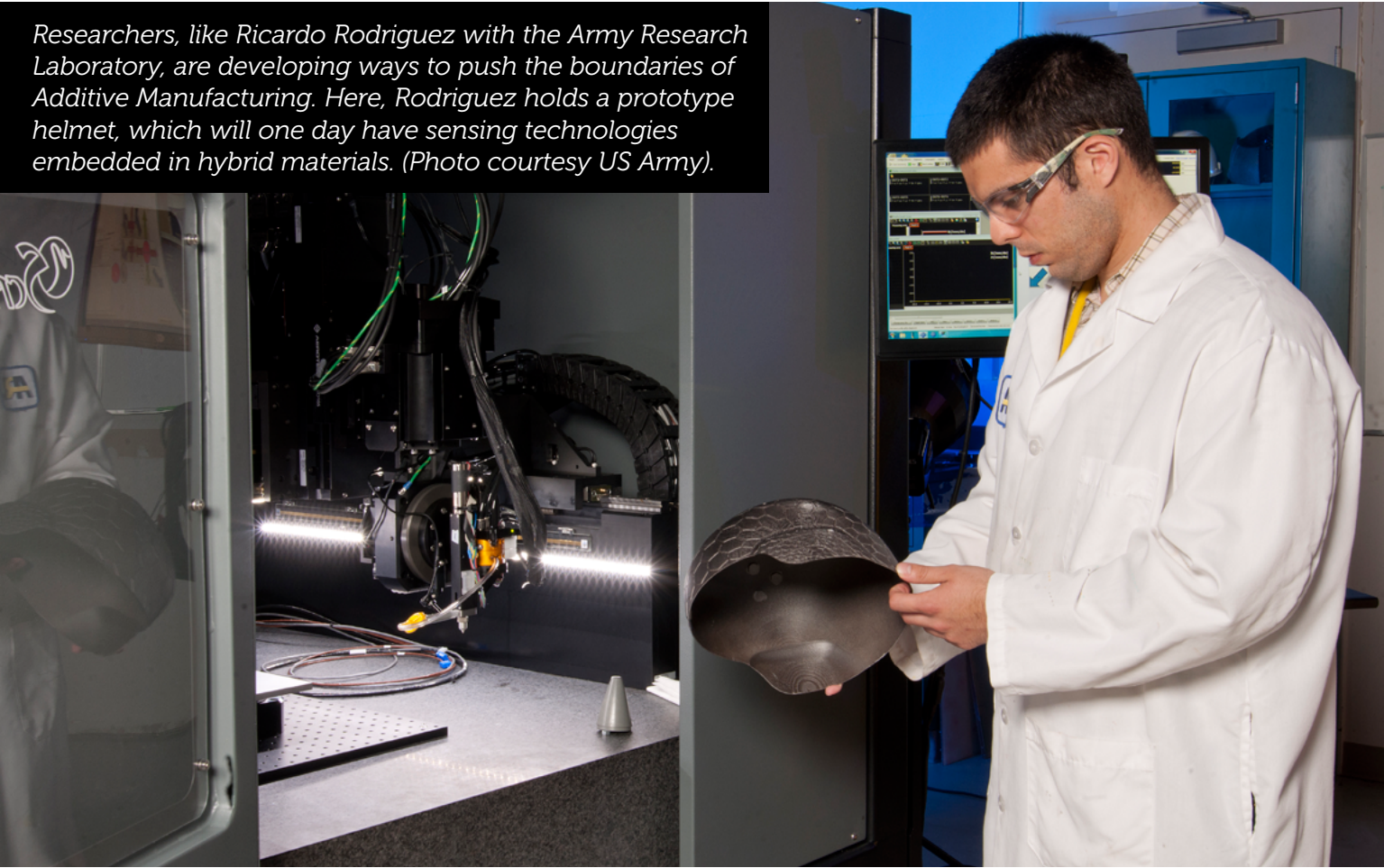
*Rick Decker
Executive Director, RAMP MD*



The Maryland General Assembly established the Northeastern Maryland Additive Manufacturing Innovation Authority with legislation signed in 2014 by former Governor Martin O'Malley, center, Senate President Mike Miller, left, and House Speaker Michael Busch, right.



The Future of Manufacturing Is Here



Researchers, like Ricardo Rodriguez with the Army Research Laboratory, are developing ways to push the boundaries of Additive Manufacturing. Here, Rodriguez holds a prototype helmet, which will one day have sensing technologies embedded in hybrid materials. (Photo courtesy US Army).



What is additive manufacturing?

Benefits of additive manufacturing:

- Speeds up product development cycle
- Quickly produce a prototype
- Experiment with various materials to impact weight, durability, or other factor
- You can make just one
- Mass customization of products
- Environmentally friendly

Additive Manufacturing is changing everything we make and the way we make everything.

Additive manufacturing is the process of producing a three-dimensional object from a digital file by layering materials, and it is revolutionizing the way products are designed and manufactured. The term additive manufacturing encompasses multiple technologies, such as 3D printing, rapid prototyping, direct digital manufacturing, just-in-time manufacturing, layered manufacturing, and additive fabrication.

The process starts with a 3D computer-aided design file. This file is sent to a 3D printer, which then creates layers upon layers of precisely measured and formed materials, such as plastics, rubber, metals, or ceramics. This is different from traditional manufacturing technologies,

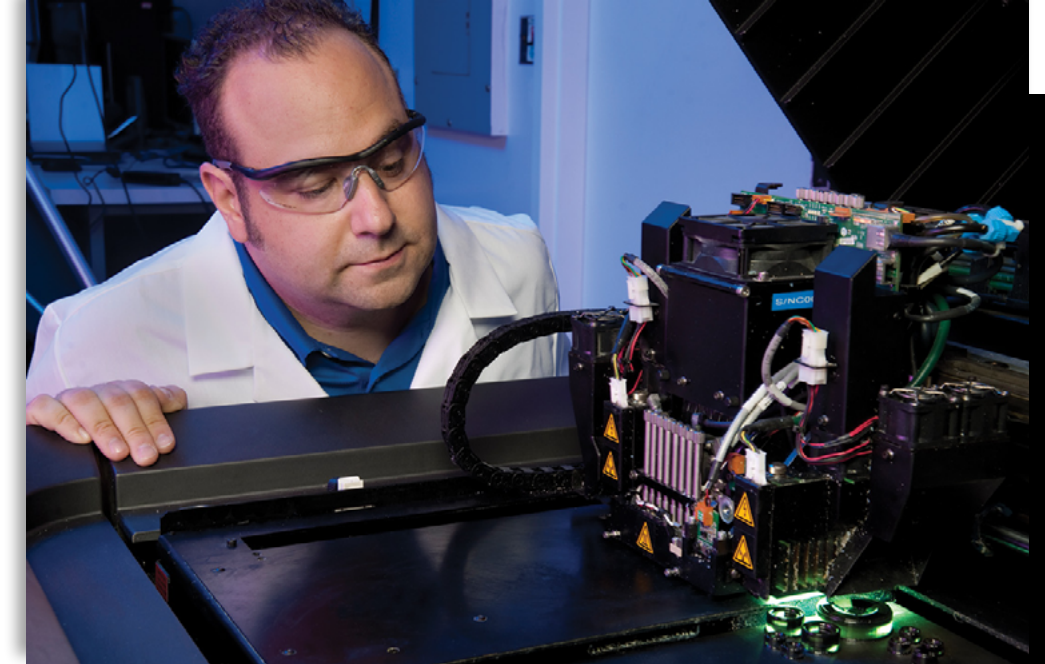
which is considered a “subtractive” process where you start with a block of material and remove what you don’t need. As a result, additive manufacturing can be more efficient, flexible, and less wasteful.

Any industry that has a manufacturing component can adopt additive manufacturing technologies. Here are examples of specific additive manufacturing applications:

- Highly specialized and lightweight medical devices
- Bio-printing of prosthetics and tissue
- Creation of models and buildings in the construction industry
- Design and manufacturing of custom and racing auto parts
- Engine and turbine parts for the aerospace industry
- Jewelry and household objects

Additive manufacturing represents a dramatic shift in how products are designed, manufactured, and ultimately distributed. At some point in the near future, a consumer will go online not to buy a product, but to buy the 3D file of that product and print it at home. As costs of printers and materials drop, and technology continues to advance, widespread use of additive manufacturing will be the norm.

Industry researchers expect the additive manufacturing sector to grow to more than \$8 billion by 2025, and reshape the entire manufacturing industry.



ECBC's Brad Ruprecht used a multi-material 3D printer to produce numerous self-sealing suction cup prototypes. Additive manufacturing produces workable samples right off the printer. (Photo courtesy US Army).



RAMP MD Partner Rick Moore explains the additive manufacturing process to Senator Barbara Mikulski during a recent visit to ECBC's Advanced Manufacturing Facilities. (Photo courtesy US Army.)

According to Lux Research, an independent research firm specializing in emerging technologies...

Additive manufacturing will be an \$8.4 billion industry in 2025. Longer term, it has potential to reshape the entire manufacturing ecosystem.



About RAMP MD

The Regional Additive Manufacturing Partnership of Maryland (RAMP MD) was formed by the Maryland General Assembly in 2014 to expand the state's capabilities in additive manufacturing. RAMP MD is a consortium of private businesses, educational institutions, and governmental agencies, working together to achieve three goals:

1. Provide businesses access to additive manufacturing facilities, equipment, and expertise
2. Build the required infrastructure to support the manufacturing base
3. Educate a supporting workforce

Through RAMP MD, companies partner with the U.S. Army Edgewood Chemical Biological Center, which has some of the most advanced additive manufacturing

capabilities in the nation and has been using additive manufacturing technology for over 25 years. The collaboration permits manufacturers to move a product from inspiration to production faster than ever.

RAMP MD currently holds partnership agreements with 12 industry partners and is in the process of negotiating more.

Part of RAMP MD's mission is to improve the accessibility of and connections between the existing resources in the region. RAMP MD does this by:

- Fostering partnerships among Federal, State, and

CURRENT PARTNERS

- RPM Tech
- Integrata Security, LLC
- NextLine Manufacturing Corp.
- Orbital ATK Missile Defense & Controls
- Danko Arlington, Inc.
- Root3 Labs, Inc.
- iDim LLC
- LEIDOS Corporation
- D. Wheatley Enterprises, Inc.
- UMBC
- Direct Dimensions
- Quicksilver

local government, businesses, educational institutions, entrepreneurs and innovators.

- Supporting manufacturing businesses in retaining and expanding production and jobs.
- Obtaining, coordinating and disseminating marketing resources to promote and enhance additive manufacturing opportunities and investment in the region.
- Facilitating the involvement of Harford Community College, Cecil College, Towson University, and other segments of the higher learning community in developing and sustaining a skilled AM workforce through degree, certification, specialized training, and continuing education programs.
- Assisting Cecil and Harford County Public Schools in preparing students for AM employment.
- Supporting priority access to workforce training funds and enterprise investment

tax credits for entities that are investing resources and creating jobs.

- Pursuing public and private funding initiatives.



RAMP MD Board Members and partners Dave Wheatley, DWE Plastics, Rod Hudson, Quicksilver, and Denise Camaggio, Chesapeake Science and Security Corridor, at RAMP MD's recent annual Symposium.

RAMP MD is off to a very strong **Year One**. In addition to establishing the 501(C)(3) non-profit charity authority, and creating the overarching Cooperative Research and Development Agreement with 12 public-private-partnership (P3) relationships between commercial entities and the US Army Edgewood Chemical Biological Center, RAMP MD held its first Symposium, which drew additive manufacturing experts from across the Mid-Atlantic. Entitled, "Additive Manufacturing: It's more than 3D Printing," the event featured speakers, workshops, and networking.

RAMP MD is also working with Maryland educational institutions to develop pathways into high-tech, high-pay additive manufacturing careers. It supported the local school systems and academic community by assisting with the development of additive manufacturing pathways, and helping the region's workforce development organizations identify training, retraining, continuing education, and certification requirements for a viable workforce.

RAMP MD is guided by a Board of Directors and managed by an executive director with extensive experience in additive manufacturing.



An important role of RAMP MD is to bring together diverse sectors to collaborate on expanding additive manufacturing. Here, board member Bruce England discusses workforce requirements with educators.

Board Members

- Randy Altschuler, Nextline Manufacturing
- Jan Baum, 3D Maryland
- Dr. Mary Way Bolt, Cecil College
- John Desmone, Towson University
- Chris Cosgrove, SURVICE Engineering
- Robert Daidone, Orbital ATK
- Bruce England, Susquehanna Workforce Network
- Jeff Fuchs, MD Advisory Commission on Manufacturing Competitiveness
- Mike Galiazzo, Regional Manufacturing Institute
- Michael Gill, MD Department of Business and Economic Development
- Mary Hastler, Harford County Public Library
- Karen Holt, Harford County OED
- Rod Hudson, Quicksilver
- Dr. Jeffrey Lawson, Cecil County Public Schools
- Rob Limpert, Harford County Public Schools
- John Mayhorne, Harford Community College
- Harry McArthur, Terumo
- Jill McClune, Army Alliance
- Dan McDermott, Upper Shore Workforce Investment Board
- Morgan Miller, Cecil County Public Library
- Mike Parker, NMTC
- Mark Schlein, Edgewood Chemical Biological Center
- Lisa Webb, Cecil County Office of Economic Development
- Dave Wheatley, D. Wheatley Enterprises, Inc.



Partnerships

RAMP MD fulfills its mission to expand additive manufacturing in Maryland by establishing public-private partnerships. Central to its partnership model is its partnership is Edgewood Chemical Biological Center (ECBC), which provides private entities access to its capability and expertise.

ECBC is the principal research, development and engineering center for non-medical chemical and biological defense for the US Army. ECBC develops technology in the areas of detection, protection and decontamination and provides support over the materiel lifecycle — from basic research through technology development, engineering design, equipment evaluation, sustainment, field operations and disposal.

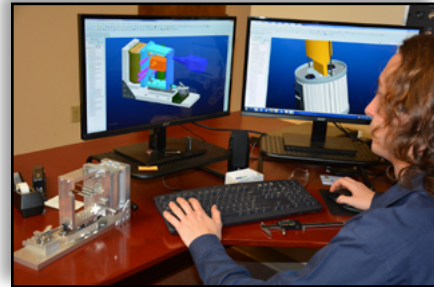
With 25 years of experience, ECBC is a leader in additive manufacturing and offers the most comprehensive additive manufacturing capabilities in the nation. Through its partnership with RAMP MD, ECBC is able to pass along lessons learned over the years to advance the private sector's capabilities and expertise — about the machines, maintenance infrastructure, materials, importance of design, and the potential applications.

The partnership is also beneficial to ECBC in that through RAMP MD, it can continue to grow and expand its capabilities and leverage the expansion of commercially available products for military application. For example, ECBC recently developed a proposal with a RAMP MD partner for development and testing of carbon nanotube filled materials

for additive manufacturing and military applications. For more information, visit www.ecbc.army.mil.

RPM Tech

RPM Tech provides technology consulting, product design and in-house prototyping to offer end-to-end solutions to the high tech industry. RPM Tech has



A technician with RPM Tech readies a drawing for printing.

been involved in a variety of military and homeland security project from design to qualification and production. Projects have included tracking, positioning devices, rugged power supplies, rugged networking modules and fabric antenna pouches. With extensive experience in communication, defense, telecom, medical, industrial, energy and commercial industries, RPM Tech has developed a broad base of partners that allow rapid development using the best technology. RPM Tech works to optimize efficiencies and reduce cost while providing superior technologies to its customers. For more information, visit www.rpm-tech.com.

Integrata Security, LLC

Integrata Security is a cyber security firm offering a suite of wireless intrusion detection and prevention solutions suitable for enterprises with the highest wireless security

concerns. Its devices combine software, network management, and hardware solutions. For more information, visit www.integratasecurity.com

NextLine Manufacturing Corporation

NextLine integrates 3D printing and additive manufacturing technologies with traditional manufacturing to produce high volumes of on-demand, unique parts, including custom components and aftermarket parts for legacy systems. Visit www.nextlinemfg.com for more information.

Orbital ATK Missile Defense & Controls

Orbital ATK designs, builds, and delivers space, defense, and aviation-related systems to customers around the globe. The company is a world-class manufacturer of composite structures

for commercial and military aircraft and launch vehicles. Orbital ATK uses additive manufacturing technology to complete quick turnaround prototype and multi-part run jobs. The company specializes in machining difficult types of materials, ranging from rubber and composites to rare materials. Visit www.orbitalatk.com for more information.

D. Wheatley Enterprises, Inc.

D. Wheatley Enterprises, Inc. (DWE) is a plastics engineering & manufacturing company that services the medical, defense, and aerospace industries. Headquartered in the Aberdeen Technology Park, its facilities cover 40,000 sq. ft. and house engineering, molding and assembly operations. A second campus located in Woodlawn, MD has full factory capability with an additional 40,000 sq.ft. of manufacturing space. DWE offers over 25 years experience integrating

injection-molded plastic products into medical, aerospace and defense systems, particularly engineered plastics for the NBC protection/detection field. For information, visit www.dweplastics.com.

Danko Arlington, Inc.

Danko Arlington is a full-service jobbing manufacturing company which specializes in military and commercial aluminum and bronze sand castings and 3-D printing of rapid prototypes and plastic production parts.

The company operates a pattern shop, foundry, and machine shop under a single roof, enabling customers to purchase plastic models & components, rapid pattern tooling, castings, and CNC machining from one source. For more information visit www.dankoarlington.com.

Root3 Labs, Inc.

Root3 Labs specializes in research and development of complex devices for high-risk or challenging environments, working with its clients to transform

ideas into prototypes and prototypes into manufactured products. Root3 Labs' products include, electromechanical device design, medical device design, mechanical design and analysis, electrical schematics and PCB layout, microcontroller selection and firmware programming, industrial design and product graphics. Visit www.root3labs.com for more information.

iDim LLC

A Harford County-based electronics manufacturer, iDim designs and manufactures lighting controls and solutions and provides residential and commercial customers with innovative technology designed to reduce energy consumption, enhance

the quality of life, and control all their lighting sources. For more information, visit www.idimllc.com.

Leidos

Leidos is a science and technology solutions leader working to address some of the world's toughest challenges

in national security, health, and engineering. The company's 22,000 employees support vital missions for our government and the commercial sector, develop innovative solutions to drive better outcomes, and defend our nation's digital and physical infrastructure from 'new world' threats. Leidos is headquartered in Reston, VA, and its local offices are in Abingdon. Visit www.leidos.com for more information.

UMBC

UMBC is a dynamic public research university integrating teaching, research and service to benefit the citizens of Maryland. UMBC emphasizes science, engineering, information technology, human services and public policy at the graduate level. UMBC contributes to the economic development of the State and the region through entrepreneurial initiatives, workforce training, K-16 partnerships, and technology commercialization in collaboration with public agencies and the corporate community. For more information, contact www.umbc.edu.

Direct Dimensions

Direct Dimensions specializes in the on-site application of digitizers, laser scanners, and the conversion of complex three-dimensional data into 3D computer models. Now 14 years old, Direct Dimensions has expanded from Aerostructures and Military Engineering applications, into cultural preservation, medical prosthetics, and even color 3D imaging for consumer applications. Please visit <http://www.dirdim.com> for more information.

Quicksilver

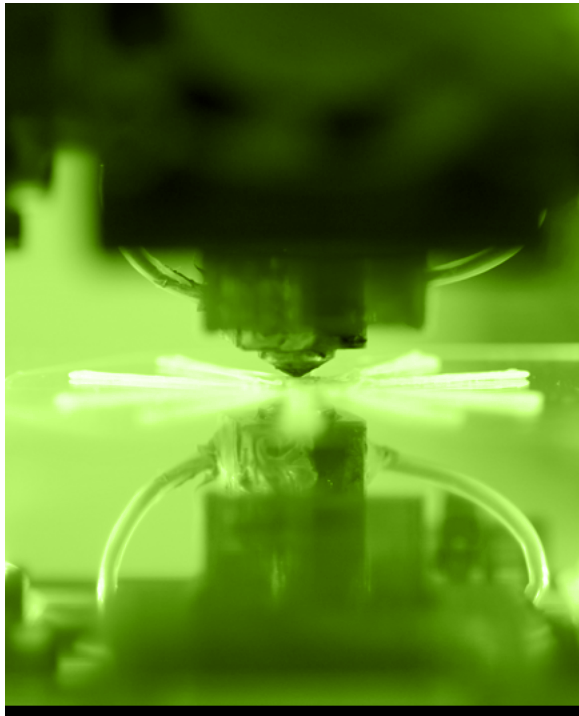
Quicksilver Analytics, Inc. (QS) is an Service Disabled Veteran Owned Small Business that provides custom chemical and biological detection products and services to the U.S. Government, civilian agencies and individuals around the world. For more information, please visit <http://www.chembiokits.com>.



At RAMP MD's annual Symposium, D. Wheatley Enterprises displayed a few of the parts and fittings that it manufactures for the Department of Defense.

RAMP MD Partners share their perspectives on the future of additive manufacturing at a recent Symposium.





2015 ANNUAL REPORT

REGIONAL ADDITIVE MANUFACTURING
PARTNERSHIP OF MARYLAND
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