



Fraunhofer  
USA

Focus  
2023

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The background features a complex pattern of overlapping, semi-transparent geometric shapes and lines in shades of blue, orange, and white. A prominent white rectangular box is centered horizontally and vertically, containing the title text. The overall aesthetic is modern and technical.

# Fraunhofer USA Focus 2023





# Foreword

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Fraunhofer USA will celebrate its 30th anniversary in the United States next year. During the past three decades, our organization has developed deep ties with industry and academia and has completed applied research and development projects for industries from tiny startups to large corporations, and many state and federal agencies.

We are especially proud of the long-term and steadfast collaborations with our university research partners in Maryland, Massachusetts and Michigan. Growing such close collaborations over many years now enables our scientists and engineers to pool human and technical resources, knowledge and experience into a unique, cohesive and comprehensive offering with the breadth and depth required to meet the needs of our customers in today's fast paced economic environment. Our mission is to bring competent technological solutions from the laboratories to market at the speed of business.

In recent years, we worked more closely with many research institutes of Germany's Fraunhofer-Gesellschaft, our founding partner organization. The goal is to provide our American partners with easier access to Fraunhofer's vast resources while at the same time exposing ever more Fraunhofer engineers and scientist to the specific needs and opportunities characteristic for the U.S. research market. After all, many technology challenges are of a global nature and thus should be addressed through global collaboration. Fraunhofer's robust international research ecosystem strengthens the research capacity of institutions and countries, leaving a legacy of improved scientific infrastructure and expertise, alongside a trained and ready workforce that can communicate solutions effectively.



Our competent team of scientists and engineers develops effective solutions to your most challenging business needs through interdisciplinary approaches and efficient research collaborations backed by substantial technical resources. Come and talk to us. We will help you to accelerate your innovation process by bringing technologies to market faster.

Sincerely,

*Thomas Schuelke*

Thomas Schuelke  
President, Fraunhofer USA, Inc.

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## **Mission**

Fraunhofer USA offers customized, advanced technology research, development and deployment. Fraunhofer USA shall serve market-driven technology needs; promote international cooperation in business; establish strategic alliances with industry, government and academic partners.

## **Vision**

Fraunhofer USA, like its founder and funding partner Fraunhofer-Gesellschaft, is a national and international leader of applied research. As an innovation driver, we lead strategic initiatives to master future challenges and thus achieve technological breakthroughs.

# About Fraunhofer USA

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## What is Applied Research?

Applied research is the systematic investigation of solving practical problems or developing new technologies, products, or processes for specific real-world applications. By bridging the gap between theoretical knowledge and practical implementation, we facilitate applied research and technology transfer by collaborating closely with industry, government and academic partners. As a legally independent affiliate of Germany's Fraunhofer-Gesellschaft, Europe's largest applied research and development organization, Fraunhofer USA fosters innovation by conducting research that aligns with market needs, providing access to advanced facilities and resources, and enabling technology transfer through partnerships pursuing shared societal goals. By bridging academia and industry, it accelerates the translation of cutting-edge research into practical solutions, thus enhancing technology adoption, economic competitiveness and societal development.

## Societal Impact

Our applied research services have a significant societal impact by driving innovation, economic growth, and improved quality of life. By facilitating the transfer of advanced research findings and technologies from the laboratory to the marketplace, Fraunhofer USA can:

### ■ Promote Economic Growth

The technology transfer process generates new products, processes, and services that lead to job creation, increased productivity, and enhanced competitiveness in industries. This contributes to local, regional, and national economic growth.

### ■ Enhance Industry Competitiveness

By enabling industries to adopt cutting-edge technologies and research-driven solutions, Fraunhofer USA helps businesses stay competitive in global markets, driving growth and sustainability across various sectors.

### ■ Address Societal Challenges

Many of Fraunhofer USA's technology transfer outcomes address critical societal challenges, such as healthcare, energy, environment, and transportation. These solutions improve public health, resource efficiency, and overall well-being.

### ■ Catalyze Research Collaboration

Fraunhofer USA's partnerships foster collaboration between academia, research institutions, and industries. This collaborative environment accelerates innovation, encourages knowledge exchange, and creates a ripple effect of positive impacts.

### ■ Education and Workforce Development

The technology transfer process often involves training and upskilling the workforce in new technologies. This contributes to a skilled workforce, supporting employment opportunities and overall societal advancement.

### ■ Disseminate Knowledge

The transfer of research findings and technologies to practical applications increases the dissemination of scientific knowledge, contributing to public awareness and understanding of complex issues.



# Strategic Research Goals

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We develop the required innovations and core competences to address the technological, commercial, and social imperatives of our time. The topics of these projects are a result of two fundamental driving forces – the industry and its technology-pull roadmap and the government and its technology push-roadmap.

These key innovations are then deployed in the U.S. R&D market where Fraunhofer USA engages with industry clients or the public sector in contract R&D projects as well as public-private partnerships (3P) for technology transfer.

As a result of this activity, Fraunhofer USA helps the industry sector to de-risk their technology development investments, improve time-to-market, enhance their competitiveness while reducing capital and operational expense, and improve quality and quantity of the product, enabling scalability and transferability of a process, reducing technology development and device integration costs.

The advantages for the public sector are access to a team of experienced, professional, inter-disciplinary researchers and scientists able to provide scalable and transferable solutions, and access to researchers with both an academic and industrial mindset and experience.





Topics of strategic relevance for Fraunhofer USA through 2024 include, but are not limited to:

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**Future Wireless and Related Technologies**

- 5G & 6G
  - IIoT and Distributed Manufacturing
- 

**Industry 4.0 and Advanced Manufacturing**

- Digital Twins
  - Additive Manufacturing
  - Vision Inspection and Predictive Maintenance
  - Process Automation, Robotics
- 

**Electrification and Hydrogen Technologies**

- Battery Technologies and Energy Storage
  - EVs and Power Semiconductors
  - Industrial Electrification and Decarbonization of Industrial Processes
  - H2-Technologies (H2-Production Efficiency and Application)
- 

**AI and Data Governance**

- Trustworthy AI and Ethics
  - AI Ergonomics and Human-AI Interaction
  - Federated Learning
- 

**Quantum Computing, Communication, Sensing and Imaging**

- Quantum Optimization, AI, Numerics
  - Advanced Materials and Diamond
  - Quantum Communications Systems for Space and Terrestrial Networks
- 

**Climate Technologies, Sustainability and Agriculture**

- Carbon Capture and Carbon to X to Y
  - Renewable Energies and Storage
  - Sustainability in Production and Materials
  - Aquaponics, Aeroponics
  - Agrophotovoltaics
- 

**Bioengineering**

- Waste and Toxin Processing (PFAS, etc.)
- Plant Based Food and Cultivated Meat
- Synthetic Biology and Genetic Engineering
- Biomedical and Neural Engineering

# Fraunhofer USA Research Centers and Offices

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# Fraunhofer USA Locations

Fraunhofer USA is headquartered in Plymouth, Mich. with three dedicated research centers located around the United States. Fraunhofer USA Center Midwest CMW, partnered with Michigan State University, has two locations in Michigan specializing in coatings and diamond technologies and laser applications. Fraunhofer USA Center Mid-Atlantic CMA, partnered with University of Maryland, is in College Park, Md., and works on AI, 5G and other software development applications. Fraunhofer USA Center for Manufacturing Innovation CMI, partnered with Boston University, is in Boston and is active in energy systems, Industry 4.0 style automation and biotechnology applications. Center directors are professors at our nationally ranked partner research universities. Additional Fraunhofer USA offices are located in California and in South Carolina – the Fraunhofer USA Digital Media Technologies Office DMT and South Carolina Fraunhofer USA Alliance, respectively. Fraunhofer USA employs approximately 100 full-time staff, university faculty, and student interns. Fraunhofer USA's 2022 revenues were nearly \$27 million.





# Fraunhofer USA Center Mid-Atlantic CMA

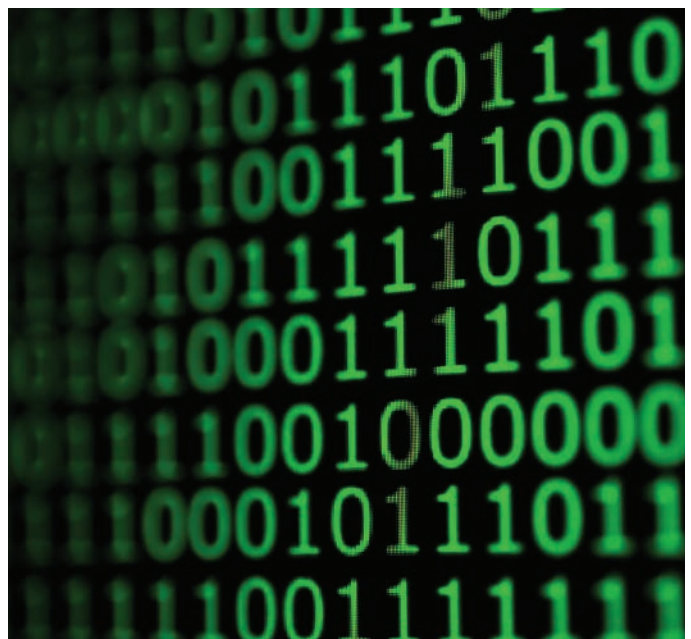
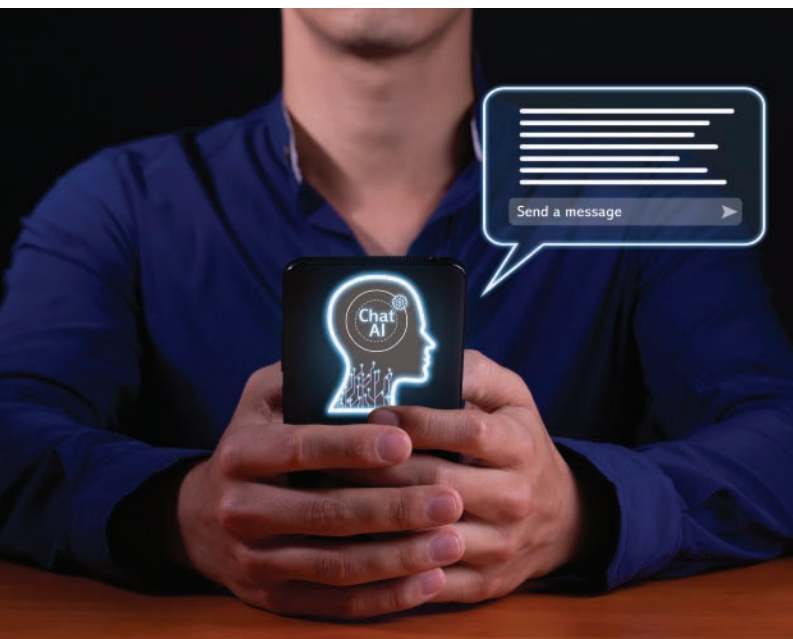
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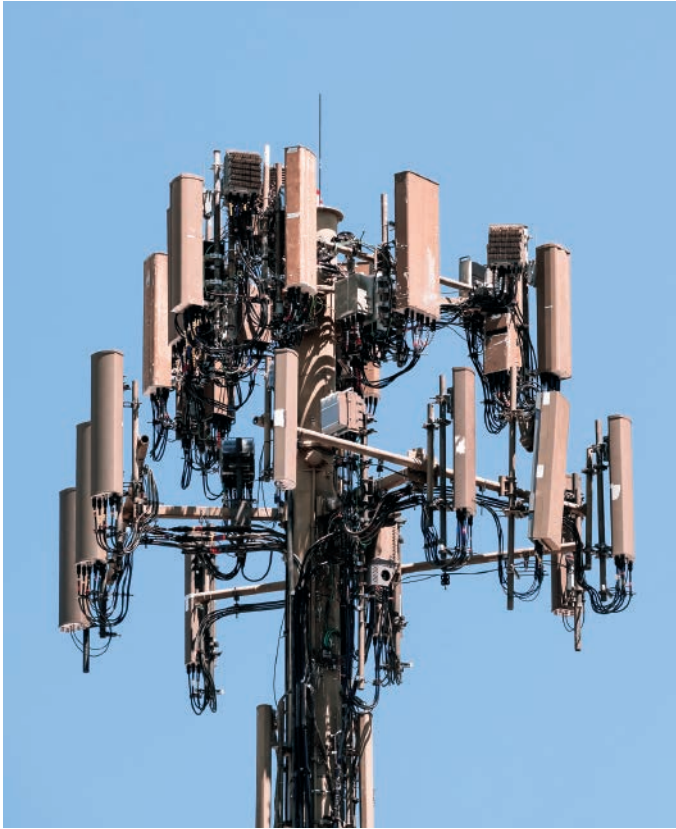
## Scientific Focus

Fraunhofer USA CMA develops and uses innovative, effective, and scalable approaches to software and systems engineering, delivers powerful testing and verification strategies and tools, uses state-of-the-art measurement and code analysis methods, and develops and tests artificial intelligence-based systems.

Fraunhofer USA CMA has developed successful collaborations with other Fraunhofer USA centers leading to joint projects utilizing competences in the physical, materials and engineering sciences. Seeking the combination of complementary competences across centers is a key strategy for Fraunhofer USA to create sustainable technology leadership.

The center leverages strategic partnerships with South Carolina, the Applied Research Lab for Intelligence and Security (ARLIS) at the University of Maryland, the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL), and a long-term relationship with NASA.





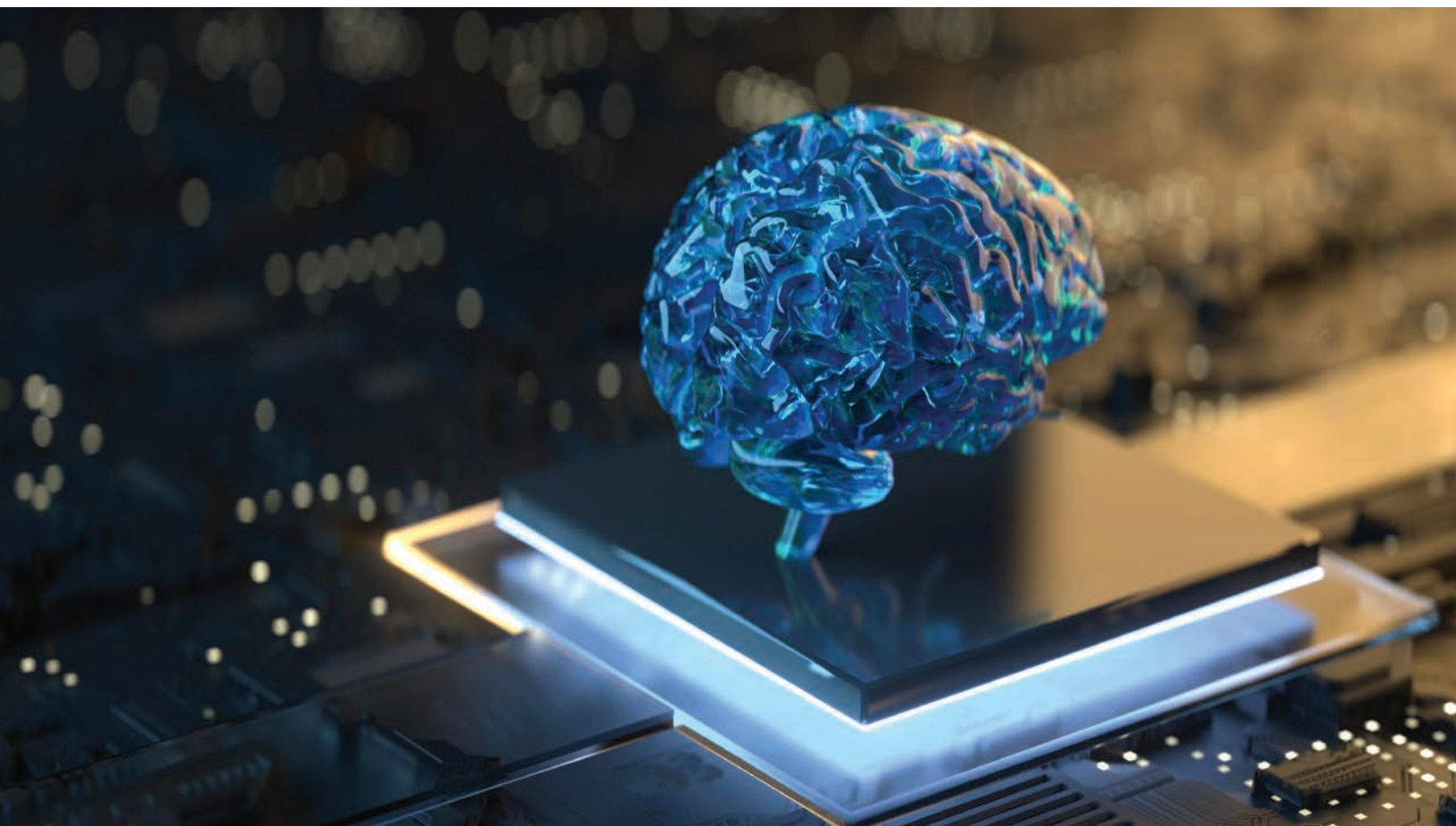
### Core Competences

#### Information and Communication Technologies

- Model-based software and systems engineering
- Software safety and security methods and tools
- Software design and development
- Software process analytics and improvement

#### Research Fields

- Applications, software, and systems infrastructure of AI-based systems
- Internet of Things
- Autonomy



# Fraunhofer USA Center for Manufacturing Innovation CMI

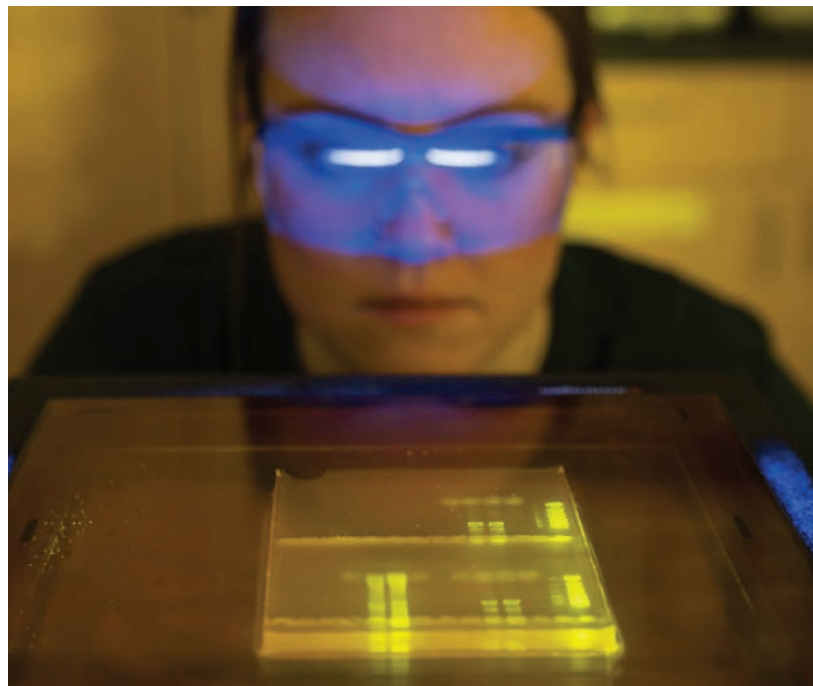
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## Scientific Focus

Fraunhofer USA CMI focuses on automation and instrumentation of systems in the industrial, energy, and biomedical technology sectors. Within the industrial technology sector, Fraunhofer USA CMI develops next generation automation systems for the aerospace/automotive, consumer products, photonics, materials processing and renewable energy markets. The center leverages expertise in engineering design and biological sciences to develop cutting-edge solutions in the biomedical space, and is active in microfluidics, biosensors, medical devices, tissue engineering, and laboratory automation.

Energy systems engineering focuses on building energy systems and grid integration. Building energy systems develops creative and quantitative means of analyzing and using data generated by an ever-increasing number of communicating sensors in buildings, combined with thermal modeling, to reduce energy consumption. In the field of grid integration, Fraunhofer USA CMI is focused on the development of efficient algorithms for integration of distributed energy sources, such as solar, wind, hydro, storage, etc. into the grid, as well as reduction of strain on the grid through load balancing. A unique advantage of the center is the combination of energy, manufacturing, and biomedical competences. For example, the center leverages its automation and manufacturing expertise to facilitate cost-effective sustainable energy solutions.

These competences will enable the next generation of industry and government customers in their pursuit of more efficient supply chains, industrial electrification and decarbonization goals, and offer a showcase for Fraunhofer USA capabilities.





## Core Competences

### Production

- Mechanical and electronic design
- Plant engineering, automation, and instrumentation
- Data acquisition and analysis

### Energy and Climate

- Model-based optimization
- Power grid integration of distributed energy sources

### Health

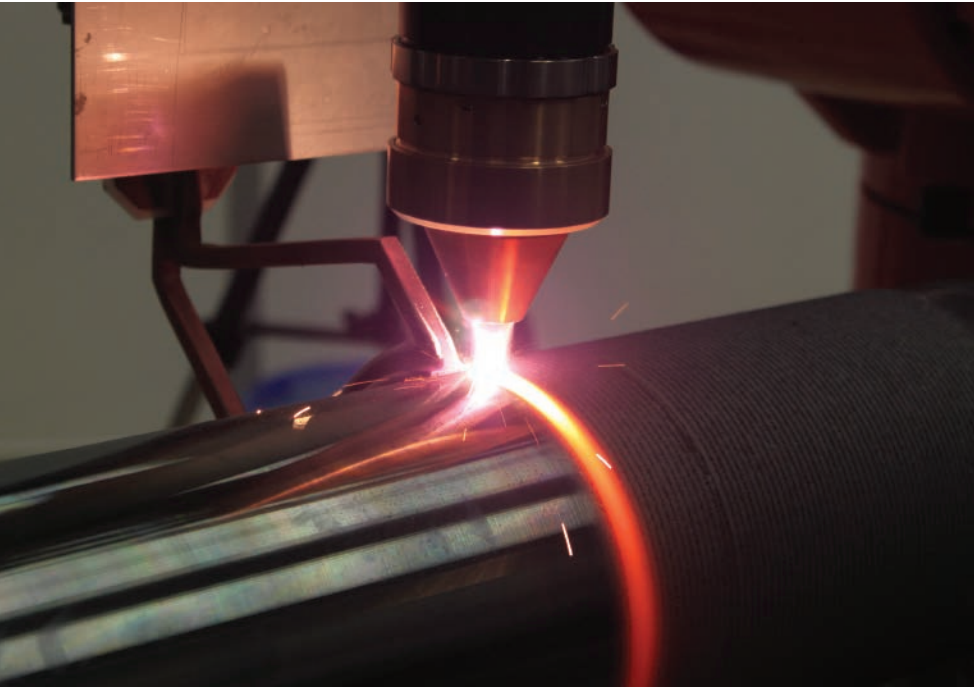
- Microfluidics
- Tissue engineering

### Research Fields

- Specialized production systems
- Healthcare devices and biosensors
- Building energy envelope
- Energy distribution systems



# Fraunhofer USA Center Midwest CMW



### Scientific Focus

Fraunhofer USA CMW performs applied research and development projects in the fields of diamond and coating materials, surface engineering, 3D printing and additive manufacturing technologies, and power laser applications. Projects involve research and development of materials, processes, devices and systems, with a focus on bridging the innovation gap between laboratory research and customer applications. Customers include government organizations and commercial clients from multiple sectors such as the manufacturing, semiconductor, biomedical and energy industries. Fraunhofer USA CMW sets a high priority on quality management and is ISO 9001 certified.







## Core Competences

### Light and Surfaces

- Surface engineering
- Coating processes and systems
- Vacuum and plasma technologies
- Direct energy powder deposition
- High-power robotic laser systems

### Materials

- Coating materials
- Diamond materials and applications
- Materials characterization

## Microelectronics

- Electrochemical sensors and methods
- Microfabrication

### Research Fields

- Power and radio frequency electronics
- Clean water
- Quantum systems
- Wear, friction and corrosion
- Optical thin films
- Thermal barriers
- Biomedical sensors and devices
- Additive manufacturing and 3D printing



# Fraunhofer USA Digital Media Technologies Office DMT

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Fraunhofer USA's Digital Media Technologies Office DMT promotes state-of-the-art technologies in this field. Fraunhofer USA DMT supports the Audio and Media Technologies division of Fraunhofer Institute for Integrated Circuits IIS in the United States.

For more than 35 years, they have been shaping the globally deployed standards and technologies in the fields of audio coding and moving picture production. Fraunhofer IIS systems and tools help create, transmit and provide excellent audio and video content as well as enable high-quality, real-time communication. Today, almost all computers, mobile phones and consumer electronic devices are equipped with Fraunhofer IIS technologies and are used by billions of people around the world every day.

It all started with the creation of mp3, then evolved with the co-development of AAC and HE-AAC. Now, the fourth generation of best-in-class audio technologies – MPEG-H Audio, EVS, LC3/LC3plus and xHE-AAC – elevates the media experience to new heights. In terms of audio signal processing, Symphoria and the Sonamic product family provide enveloping and enhanced sound in cars, while the upHear product family dramatically improves 3D audio playback or recording quality of professional and consumer devices. Fraunhofer technologies also power digital radio in the form of the ContentServer, which combines audio encoding, multimedia data management and multiplexing. In the field of moving picture technologies, establishing the Digital Cinema Initiative test plan boosted the creation of professional tools for digital film and media production, such as easyDCP. The JPEG XS solutions facilitate the transfer to all-IP workflows.





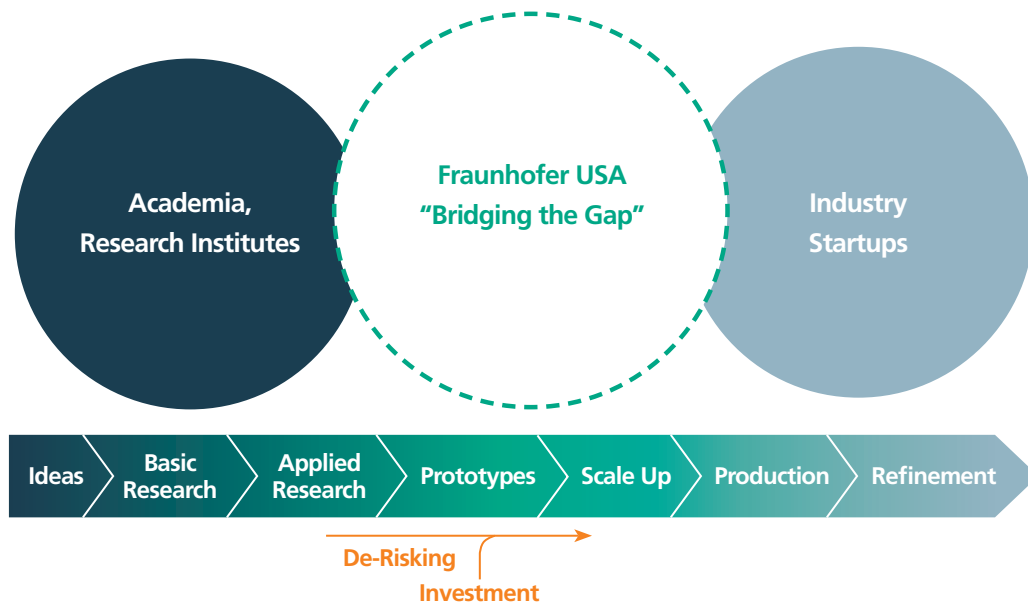


# Work with Us

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Fraunhofer USA brings cutting-edge research and development and a highly trained staff to tackle the toughest problems for our customers. We bridge the gap between academic research and industrial needs, and leverage both in doing so. Our industrial clients include large multi-national companies, SMEs, and startups, in addition to government organizations. We also collaborate with renowned research organizations, universities, and other networks to fulfill our mission of improving the world through the application of advanced technologies.





## Bridging the Gap: How to Engage with Fraunhofer USA

Fraunhofer USA employs several strategies to bring technology to market for our government and industry customers. By partnering with industry leaders to identify market needs and co-develop solutions, our joint collaborations often lead to the commercialization of technology by integrating it into existing products or launching new products altogether. We can support startup companies based on promising technologies developed in their labs and showcase our research outcomes at industry events or trade shows. We are also actively engaged in technology transfer programs that aim to transition research findings into practical applications, often with government support and grants. We often generate intellectual property through the work of our research scientists and this technology is also available for licensing to interested companies. By offering our collective expertise in market analysis, business planning, and technology validation, we bridge the gap between research and commercialization, further fostering innovation and economic growth.

### Information for Industrial Clients

For nearly 30 years, large and small companies have turned to Fraunhofer USA for assistance in solving their most challenging problems. Through our structured and rigorous approach, we mix emerging research with state-of-the-art technologies to develop custom solutions not available in the marketplace. We work in

many industry sectors, including but not limited to: biotech/ biomedical, consumer products, aerospace, materials, additive and advanced manufacturing, automation, energy and any other sectors interested in Industry 4.0 technology solutions. Our clients typically engage with us in two ways:

### Joint Government Funding

Fraunhofer USA can support companies applying for government funding, in the form of joint proposals or as R&D subcontractors with letters of support. We participate in both large-scale government programs as well as SBIRs and are in compliance with all pertaining government regulations for such funding.

### Contract Research and Development

We offer a free-of-charge assessment as to whether our organization can help address your needs and then provide a proposal as to how we can be of service, typically under a non-disclosure agreement. All of our proposals include a phased approach to mitigate risk, a clear statement of deliverables, milestones, and cost. We have a flexible and transparent intellectual property policy which works well for both large and small companies.



## South Carolina Fraunhofer USA Alliance

After years of fruitful partnership with the State of South Carolina, including state funding of three research projects between Fraunhofer IESE and selected state universities, the South Carolina Fraunhofer USA Alliance was formally established in 2019 by the South Carolina Council on Competitiveness (“SC Competes”). The Alliance is a collaboration of SC Competes, a statewide non-profit organization that provides administration, industry and academic engagement, and management to the Alliance, Fraunhofer USA, representatives from key industries, and South Carolina academic partners such as Clemson University, College of Charleston, and the University of South Carolina.

The State of South Carolina has provided support which also advance the Fraunhofer USA corporate mission of providing cutting-edge technologies and advanced applied research to companies and organizations of all sizes in order to support them in being as globally competitive as possible. This program, now in its fourth year, offers state governments, economic development agencies and academic institutions the opportunity to develop technical assistance programs based on the Alliance template and is tailored to the states’ specific needs and interests.

The program works to assist local businesses with the challenges and opportunities presented by rapid technological change in manufacturing processes, product development and service delivery. The State of South Carolina provides approximately \$2 million to the South Carolina Fraunhofer USA Alliance per year in 1:1 funding to match industrial monies. To date, more than 30 projects have been co-funded with matching monies for the automotive, energy, aerospace, life science and logistics sectors of the state. South Carolina is home to more than 220 German companies such as BMW, Bosch, Continental, Schaeffler, MTU, Mercedes Benz Vans and more. Representatives from BMW and Bosch currently both serve on the South Carolina Fraunhofer USA Alliance Review Board providing “voice of industry” perspective.

Since its inception, the Alliance Program team has worked with companies involved in aircraft subsystems, bicycle manufacturing, thermoplastics, appliances, shipping and logistics, telemedicine, auto assembly, and many others. Projects have focused on reducing defects

in assembly operations, image analysis, workforce training and onboarding process improvements, capturing data and integration of data sets for better insights into operations, and automation of manual production tasks to allow workers to focus on higher value.

The variety of industries and challenges addressed speaks to the Alliance Program team’s capacity and capability to take on tough issues facing companies large and small, and delivering success where off-the-shelf solutions do not exist. The technical areas include wearables, artificial intelligence, Industry 4.0, advanced quality management, and robotics.

For more information on the South Carolina Fraunhofer USA Alliance contact Dr. Marcel Schaefer at [mschaefer@fraunhofer.org](mailto:mschaefer@fraunhofer.org).

## Fraunhofer USA TechBridge Program

The Fraunhofer USA TechBridge program works with corporations and startup companies to identify and de-risk promising technologies to solve industry challenges. By performing targeted technical searches and conducting validation and demonstration work, TechBridge evaluates and prepares innovative early-stage products for investors and industry.

The current TechBridge program, known as the Carbon to Value Initiative (C2V Initiative), is a unique partnership between Fraunhofer USA, Greentown Labs, and the Urban Future Lab at New York University-Tandon. The three-year C2V Initiative will connect innovative young companies with industry leaders in chemicals, advanced materials, energy, and other sectors that can provide resources and market access necessary to enable rapid commercialization of carbontech.

Currently in year three, the C2V Initiative will also create a first-of-its-kind collaborative ecosystem among carbontech innovators and leading corporations with the end goal of making carbontech cost-effective and achieving its deployment at scale. A select group of corporate, academic, and government thought leaders will be invited to join the program’s Carbontech Leadership Council (CLC) to foster commercialization opportunities and to identify avenues for technology validation, testing, and demonstration. Through participation in the CLC, corporations will both advance their sustainability goals, and take a leadership role at the forefront of a new industry, as the world seeks to rapidly decarbonize in response to climate change.

Members of the CLC will create a technology roadmap for the future of the carbontech industry and will also have the opportunity to work closely with the highly-selective first cohort of startups participating in the C2V Initiative.

Program lead partners Fraunhofer USA, Urban Future Lab, and Greentown Labs, have strong experience jointly curating, testing, and launching successful game-changing climate solutions into the marketplace. The combination of incubation space, innovation services technical testing capacity and know-how they provide forms the basis of a highly unique and proven technology acceleration model that will now be applied to carbontech as part of the C2V Initiative.

### Applied Research Consortia (ARC) Project

Industry-led R&D consortia are a proven approach to productive pre-competitive collaboration among multinational businesses, large and small. In such consortia, intellectual property and know-how can be protected even as it is shared among partners and consortium members. The most effective pre-competitive R&D consortia are hosted by, or adjacent to, major research universities. They are structured to be amenable to supporting public R&D investments and promote the participation of university-based researchers, and engage undergraduate and graduate students in industry-defined research.

The ARC Project will develop, and advocate for, industry-led cross-border R&D consortia across a range of pre-competitive challenges and opportunities.

In launching the ARC Project, Fraunhofer USA draws upon decades of successful experience, both in the U.S. as well as globally, in contract R&D for industry and governments. Fraunhofer's experience includes both multiclient R&D projects and industrial applied research consortia. That breadth and depth of experience means that Fraunhofer USA, independently and drawing on the 76 institutes of Fraunhofer-Gesellschaft, can serve as start-up organizational host and interim steward for industry-led consortia across an unparalleled range of pre-competitive R&D challenges.

### Research Scholar Program

Fraunhofer USA offers a research scholar program. International researchers can come to the United States through our J-1 Research Scholar program and perform applied research at Fraunhofer USA for a period of 1 to 3 years. This program offers Post-Doc positions and provides opportunities for early career scientists and engineers to obtain hands-on experience, which can facilitate knowledge transfer and support the progress of science and technology to the greater benefit of society.

### Intern Program

Fraunhofer USA is committed to offering opportunities for meaningful, hands-on internships for those studying in STEM fields to both international and domestic students. Over the last 29 years, Fraunhofer USA has hosted thousands of interns from many countries and backgrounds, supporting and encouraging curious minds as they lay a solid foundation to help support the critical STEM fields that we all rely upon. Internships are available for U.S. and international interns at our three research centers. Interns are closely mentored and find the experience very rewarding. Fraunhofer USA has a J-1 Visa program that provides us with the capability to obtain an intern's visa if the intern is not authorized to work in the U.S..



# Select R&D Projects

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Highlighted research showcases Fraunhofer USA's ability to bring technology to market, collaborations with university and government partners, and our efforts to progress transatlantic collaboration in science and technology. Our additional engagement with Fraunhofer-Gesellschaft institutes provides additional insight into our strategic research focus and partnership.

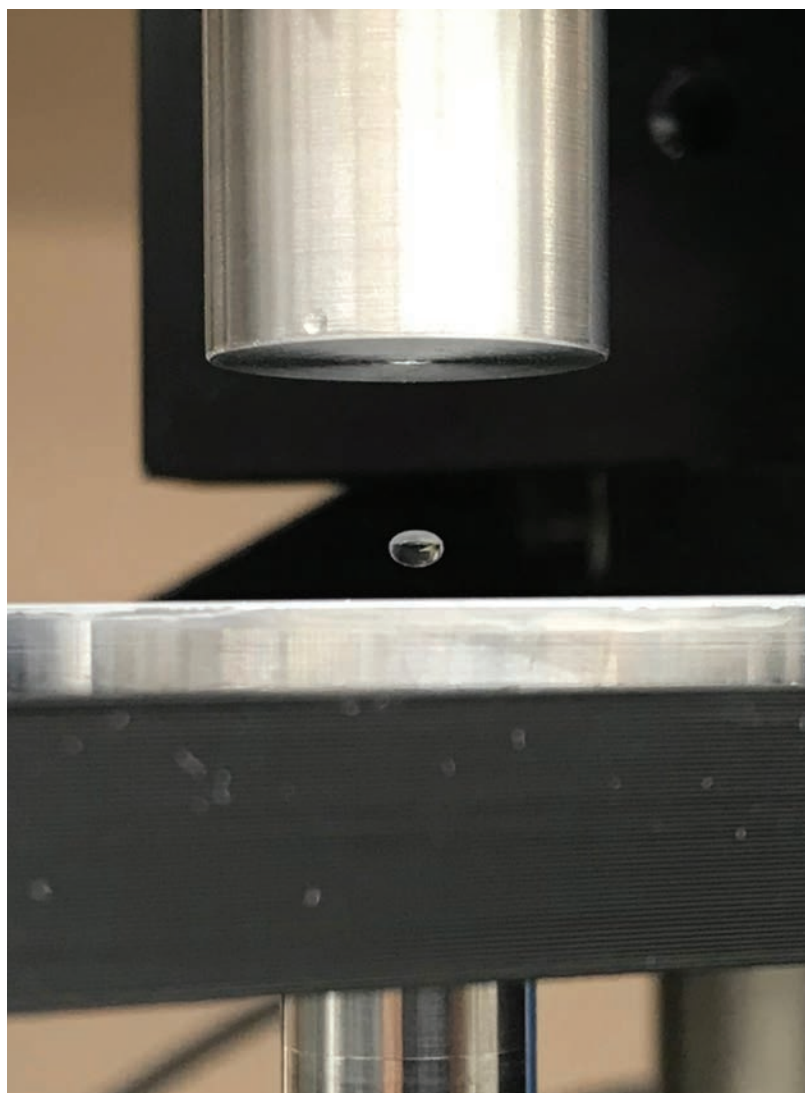
# Bringing Technology to Market

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## Monitoring Blood Coagulation Using Acoustic Levitation for Levisonics

Monitoring blood coagulation is critical for neonatal and pediatric care, surgical patients, and for those on blood thinning medications. Current methods for measuring coagulation rates require 10 mL venipunctures of blood and expensive laboratory-based tests. These large blood volumes are a significant loss for sick patients and are almost impossible for children and infants to provide. Current blood coagulation tests are artificially triggered by contact with the instrument. To solve this problem, Levisonics, with NSF support, has developed a novel, non-contact blood coagulation test that uses acoustic force to levitate blood drops. To help bring the test to market, Fraunhofer USA CMI helped develop key components and automate drop deployment.

For the Levisonics test, just 6  $\mu\text{L}$  of blood is required – a substantial reduction from current methods. Importantly, these blood volumes are available from simple finger or heel sticks, enabling widespread use in pediatrics and home care. In this platform, a drop of blood is levitated in an acoustic standing wave. Increasing the acoustic force gently squeezes the droplet and the degree of deformation is recorded on camera. As the blood coagulates and becomes more viscous, more force is required to deform the drop. This data is converted into a coagulation curve and has been shown to match the current gold standard. Fraunhofer USA CMI is automating the process such that the user simply inserts the blood sample and the liquid handling system automatically deploys the drop into the acoustic field for testing. This will allow blood coagulation measurements at the bedside, in local clinics, and ultimately, at home. Overall, the Levisonics platform is projected to improve the diagnostic response time up to 350% and decrease the cost of blood coagulation testing by over 30%. Projected savings for U.S. patients is at \$2 billion annually.



## Reducing Chemical Waste and Manufacturing Costs for Integrated Micro-Chromatography Systems, Inc.

The South Carolina Fraunhofer USA Alliance (SCFUSA) is a collaborative effort between the South Carolina Council on Competitiveness (SC Competes), the South Carolina Department of Commerce, and the Fraunhofer USA network. The alliance was created to advance applied research across the state of South Carolina with the Fraunhofer USA network and South Carolina research institutions.

In 2022 the South Carolina Fraunhofer USA Alliance Review Board co-funded an applied research project, led by Clemson University and Fraunhofer USA, focused on providing a key deliverable – to develop Integrated Micro-Chromatography Systems, Inc., (IMCS), an improved bacterial host and new intellectual property to further secure the company's long-term operations. IMCS previously relied on pre-templated bioreactor runs with limited optimizations and the bacterial host for the existing process was purchased routinely from a third party. This was not ideal for production use as it requires a significant quantity of chemicals to support the process at that time.

IMCS desired to provide a commercially available product for the treatment of various neurological diseases such as Alzheimer's, Parkinson's, and Huntington's. According to the Mayo Clinic,

3 million cases of Alzheimer's disease are diagnosed in the U.S. every year. Additionally, more than 200,000 cases of Parkinson's disease and approximately 30,000 cases of Huntington's disease are diagnosed annually. Traumatic brain injury, impacting nearly seven million Americans, is another neurological injury that may benefit from this compound.

As a result of this successful collaborative project, the newly developed process using enzymes, called chemoenzymatic manufacturing, resulted in three significant improvements to IMCS's competitive process:

- Reduction in manufacturing cost by several orders of magnitude
- Increase to the stability and robustness of IMCS supply chain due to vertical integration
- Significant reduction in chemical waste disposal costs

IMCS, a Columbia, South Carolina-based life-sciences company, was founded in January 2013, by Andrew Lee, Qian Wang and William Brewer, three Ph.D. scientists from the University of South Carolina (USC). Its rapid success stemmed from the company's unique technology, the founder's experience running other biotechnology companies and support from the city of Columbia, the USC and the local USC-Columbia incubator program.







### Dielectrophoresis-Enhanced Capture of Metal Cations in Produced Water with Scion Plasma

The extraction of oil and gas from underground reservoirs brings with it a companion known as “saltwater” or “brine,” collectively referred to as produced water. This produced water accounts for a staggering 24 to 25 billion barrels annually in the United States alone. However, these waters are often rejected into wells due to their high concentration of metal ions (such as sodium, magnesium, calcium, and others). Their unsuitability for industrial use or irrigation underscores the need for effective treatment. However, with the right deionization treatment, we can not only recover these valuable metals but also transform this water into a freshwater resource for various critical purposes – including irrigation, municipal supply, mining, livestock, power generation, and manufacturing – thereby alleviating the stress on both surface and groundwater sources.

Currently, several deionization technologies are adopted, including reverse osmosis, ultrafiltration, distillation, electrodialysis, and capacitive deionization (CDI). Among these, CDI stands out as a promising option due to its low energy consumption and straightforward operation compared to other methods. Nevertheless, its efficiency

is hampered by a need for slow water flow to allow ample time for ions to reach the electrodes. This limitation arises from the presence of large ion-water clusters and the small electric field between the electrodes.

Fraunhofer USA CMW, in collaboration with Scion Plasma LLC, a spin-off startup from Fraunhofer USA, has introduced an innovative approach: electro-active adsorption of metal ions in produced water. By harnessing electrophoresis and dielectrophoresis, the drift velocity of the cations is significantly enhanced in comparison with conventional CDI technology. This breakthrough leads to a more efficient deionization process. This patented discovery has earned recognition from the U.S. Department of Energy Small Business Technology Transfer (STTR) Program, supporting our efforts to develop an electro-active adsorption technology specifically designed to capture metal cations in produced water. Through the exploration of electrical fields and other variables, our team will validate the scalability and practicality of this pioneering electro-active adsorption technology. The successful demonstration of this technology has the potential to revolutionize conventional CDI deionization processes, making produced water recycling more efficient and sustainable than ever before.

# University and Government Collaboration

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## University Partnerships

### University of Maryland

The Fraunhofer USA Center Mid-Atlantic CMA has collaborated with the University of Maryland since 1997, specifically within the College of Computer, Mathematical and Natural Sciences. Founded in 1856, the University of Maryland has an enrollment of approximately 41,000 students, of which circa 11,000 are graduate students. The University of Maryland has become one of the nation's leading public research and innovation universities, with \$1.1 billion combined research expenditures in FY21 with the University of Maryland, Baltimore.

### Boston University

The Fraunhofer USA Center for Manufacturing Innovation CMI has collaborated closely with Boston University (BU) since the center's inception in 1995. The center is located on the BU Charles River campus. Boston University has a student body of more than 34,000 students of which circa 16,000 are graduate students. As a leading global research institution, BU has been awarded more than \$645 million in research awards in FY 2023. Fraunhofer USA CMI collaborates directly with several of BU's schools and colleges, including the College of Engineering, the Medical School, the Business School, and the College of Arts & Sciences.

### Michigan State University

Since 2003, the Fraunhofer USA Center Midwest CMW and Michigan State University (MSU) have closely collaborated on applied research and development projects in the areas of diamond and coatings technologies. Michigan State University, founded in 1855, has a total of approximately 50,000 students, with more than 11,000 graduate students. Michigan State University is a top 100 global research university, with total research expenditures for MSU totaled approximately \$759 million in 2022. Fraunhofer USA CMW collaborates closely with the College of Engineering and Natural Sciences.

“Fraunhofer USA’s unique offering provides us with a true innovation collaboration that is able to transfer technology while also transforming the next generation of professional engineers.”

– Leo Kempel  
Dean of Michigan State University  
College of Engineering



### Simulated Finish Panel Blocks for Low-Cost Residential Retrofits for New York and the U.S. Dept. of Energy

Tens of Millions of U.S. homes have inadequate wall insulation, reducing comfort and increasing energy consumption. The current state-of-the-art affordable retrofit insulation can achieve R-10 insulation using the “drill-and-fill” cellulose wall cavity technique. There is a strong market for affordable retrofit insulation technique that can achieve much higher R-values.

With support from the DoE Building Technologies Office (BTO) Advanced Building Construction (ABC) program, Fraunhofer USA CMI is developing an integrated digitized process using prefabricated insulated Panel Blocks (PBs) with integral clapboard-look vinyl siding cladding. A new program with the New York State Energy R&D Authority (NYSERDA), will extend that to a masonry-look insulated PBs. The blocks, which will provide R-24 insulation and clapboard and masonry looks, can combine for an architecturally pleasing aesthetic. Ultimately, we will deploy the M-PB system on a residential building and monitor its performance during both heating and cooling seasons.

One unique innovation is the integration of insulation and masonry-like cladding in one residential product. A second is a digital workflow that speeds up the retrofit process and reduces its cost.

Digital tools enable mass customization of PBs to greatly reduce on-site labor and the installation costs. Prototype testing of the lightweight polyisocyanurate foam PBs, ~1' x 4' by 4" thick, installed over the existing cladding increased wall R-value by ~R-24 while reducing wall air leakage by ~80%. The system works as follows:

1. Scan-to-BIM: Algorithms analyze point-cloud data from building laser scans to generate dimensionally accurate building information model (BIM).
2. Panelization: Optimal PB set is algorithmically determined.
3. Offsite PB CAM: A CAM process produces the cladded-PBs.
4. AR-assisted Install: An augmented reality (AR) experience empowers workers, guiding the PB installation by highlighting which PB to install and position on the façade.

The cost of this panel blocks system is comparable with traditional vinyl siding, while providing superior energy performance and aesthetics. This capital-lean installation approach is compatible with existing small contractors' business models and obviates the need for cranes required for larger panelized construction techniques.



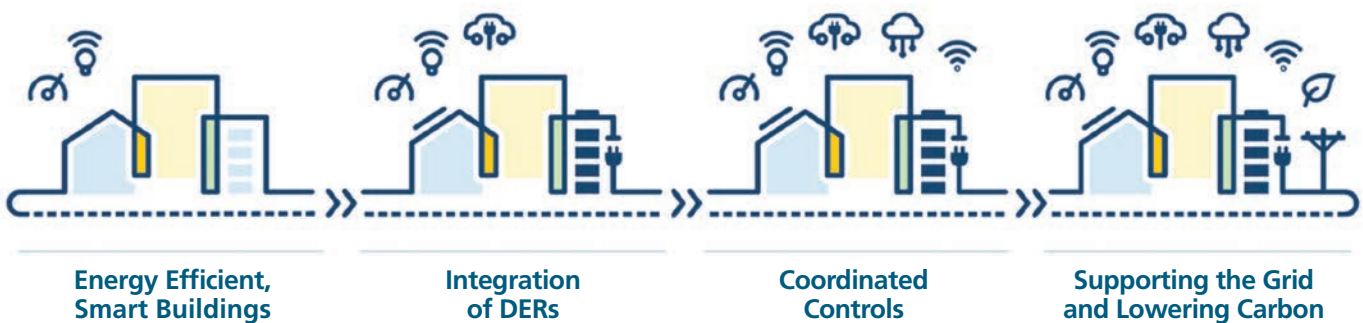
## Gateway Cities Unplugged: (em)Powering Affordable Housing for the U.S. Dept. of Energy

The increasing prevalence of distributed energy resources (DERs), such as flexible, controllable building loads, rooftop solar, and battery energy storage, offers the potential for buildings to transition from passive energy consumers to active participants in local and regional energy markets. These “Grid-Interactive Energy-Efficient Buildings” (GEBs) can reliably and cost-effectively serve as assets to the power grid by dynamically managing their energy consumption in response to changing grid conditions, thereby reducing carbon emissions, cutting energy costs, and enabling further deployment of distributed renewables. Further, coordinating control across a network of GEBs can magnify the impact of this dynamic load-shaping, both by increasing the total magnitude of controllable load, and by increasing robustness to uncertain conditions.

Fraunhofer USA CMI, in collaboration with WinnCompanies’ energy services arm, is conducting a pilot program to deploy GEB technologies in Low and Moderate Income (LMI) Multi-Family (MF) housing. This work, funded under the US Department of Energy’s Connected

Communities Program, seeks to empower LMI communities by defining, evaluating, installing, and optimizing real-world GEB packages specific to existing multifamily buildings. For example, by installing and integrating in-unit controllable thermostats, electrochemical storage, and/or onsite solar PV in a building and integrating these technologies with coordinated controls, a MF GEB can proactively shift demand away from periods of peak stress on the electrical grid while increasing tenant comfort. This work is of particular importance, as affordable multi-family housing has traditionally been underserved by emerging innovations in the deployment and control of DERs for a variety of reasons, such as limited capital budgets; split incentives between owners and tenants; and buildings that may be too small to attract the attention of energy service companies.

The optimal combination of GEB enabling technologies will be defined across a portfolio of multifamily buildings and evaluated based upon cost-effectiveness, grid issues addressed, technical feasibility, and resident satisfaction. Based on these findings, Fraunhofer USA CMI will work with WinnCompanies to identify and develop financeable GEB technology packages that can be widely scaled across the multi-family housing sector.

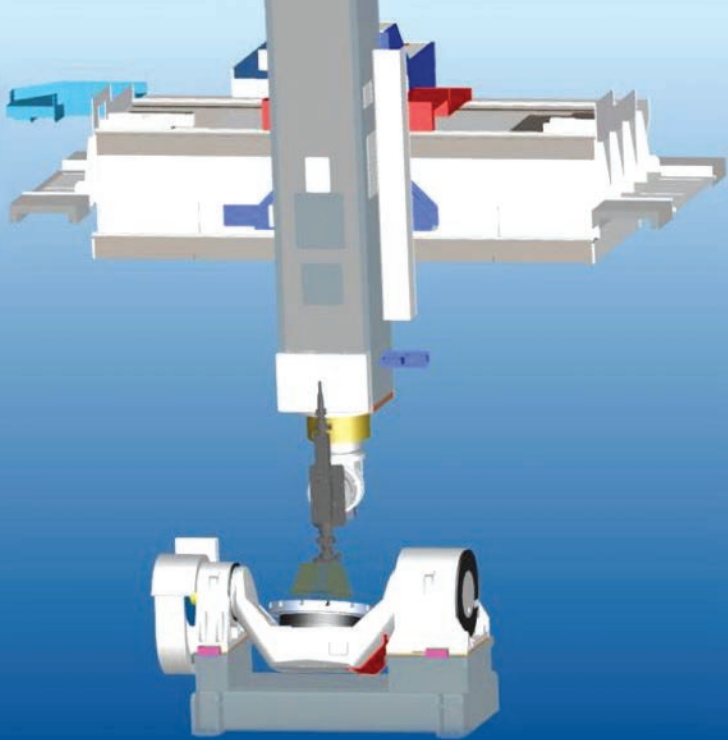




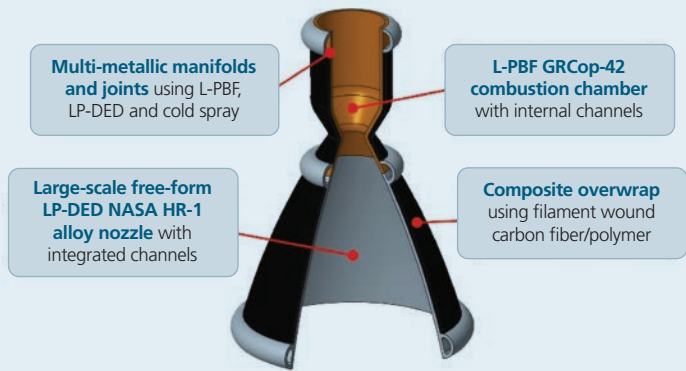
### Developing Filters with High Selectivity for Oil and Water Separation with Michigan Translational Research and Commercialization

Industry production consumes vast amounts of water while simultaneously generating colossal volumes of wastewater laden with various pollutants, raising alarming environmental concerns. Among these contaminants, oily wastewater stands out as a significant contributor. For example, the mining industry produces 140,000 L of oil-contaminated water each day. Additionally, oil leaks and spills during marine transportation and oil production further exacerbate contamination in lakes, rivers, and natural resources. It's undeniable that recycling and purifying wastewater can have profound global benefits. To address these pressing issues, a diverse range of methods have been developed to remove the oily contamination from water. These techniques span from physical (e.g., skimmers, adsorption), chemical (e.g., in-situ burning, solidifier, dispenser), to biological (e.g., microorganism degradation). However, each of these methods encounters its unique limitations across different scenarios, including concerns about efficiency, cost, and selectivity.

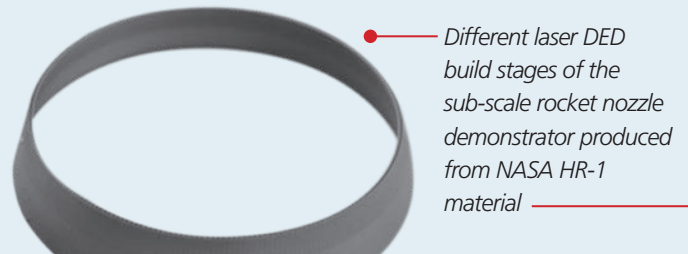
Researchers at Fraunhofer USA CMW, fueled by funding from Michigan Translational Research & Commercialization (MTRAC) Tier I project, are developing a selective biochar adsorbent for oil/water separation using innovative plasma technology. The core of this technology involves the transformation of cost-effective biochar derived from sustainable biomass into a super-efficient adsorbent through plasma treatment. Remarkably, this entire process can be completed within minutes, making it both time and energy-efficient. Leveraging its inherent porous structure and high specific surface area, the biochar adsorbent swiftly captures oil phases, regardless of its form in water. What sets this innovation apart is its remarkable selectivity, as it selectively absorbs oil while repelling water. Ultimately, researchers aim to create a continuous oil/water separation system using this highly selective, cost-effective biochar adsorbent. The integration of this system into various industries holds the potential to selectively eliminate oily pollutants from wastewater prior to discharge. While the successful completion of this project promises not only to safeguard the pristine waters of the Great Lakes region but also pave the way for widespread adoption of oily wastewater recycling across the nation.



DCAM model of Arnold CNC machine and nozzle tool path



© NASA – RAMPT technology overview



### Laser DED Additive Manufacturing of Subscale NASA Rocket Nozzles

Fraunhofer USA Center Midwest Laser Applications (CMW-LA) recently completed a project with NASA Marshall Space Flight Center as part of the RAMPT (Rapid Analysis and Manufacturing Propulsion Technology) research project in conjunction with Auburn University.

Fraunhofer USA's role was to explore the feasibility of developing a thin wall laser powder DED additive manufacturing process for building sub-scale rocket nozzle structures with integrated cooling channels.

The project was carried out using a new state-of-the-art precision CNC machine from Arnold GmbH (Revensburg, Germany) which was recently installed at Fraunhofer CMW-LA's laser research laboratory.

The machine was programmed using off-line 3D CNC CAD/CAM "DCAM" software from SKM Informatik GmbH (Schwerin, Germany) in order to slice the 3D part models into thousands of sections. This process is necessary for creating the complex 3D CNC programming code required for the CNC machine tool path motion needed to build larger scale parts using the Laser DED process.

The metal powder material used for the process was a NASA-developed alloy called NASA HR-1 (HR = hydrogen resistant) which provides a reasonable trade off in material properties in terms of the required thermal conductivity, high yield strength, low cycle fatigue, elongation, density and hydrogen resistance over other superalloys.

L-DED technology is more suitable for additive manufacturing larger scale parts which was not possible with current L-PBF machines.

The size and scale of the part build is only limited by the work envelope of the CNC or robotic motion system employed for the process.

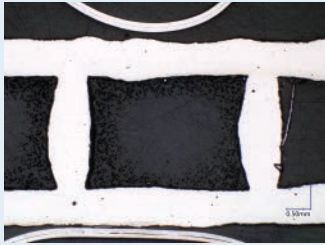
The figures above illustrate examples of thin wall structures built using the L-DED process at Fraunhofer USA CMW-LA. They demonstrate the feasibility of producing solid high density thin wall (~0.6mm thickness) structures with integrated cooling channels using a Fraunhofer Institute for Material and Beam Technology IWS COAX® 14 laser deposition nozzle.

However, as the build height increases and the nozzle cone profile deviates further from the vertical orientation, the process stability and tool path programming become increasingly challenging. This difficulty arises from the high precision required to meet the fine resolution of the part design with approximately 0.6mm thickness build track width /wall thickness. Additional work is ongoing to improve the process tolerance for more complex build geometries moving forward.

Another part of the project involved developing a process for deposition of Inconel 625 alloy onto the outer wall of a NASA provided laser powder bed fusion (L-PBF) GRCo-42 copper alloy combustion chamber. A process was successfully developed using a Fraunhofer IWS COAX® 8 nozzle for powder deposition. This process used a KUKA robotic cell, and DCAM was again used for offline tool path programming and simulation.

The entire outer contour was successfully deposited with Inconel to fabricate a bimetallic combustion chamber. This completed chamber was subsequently delivered to NASA for further testing and evaluation.



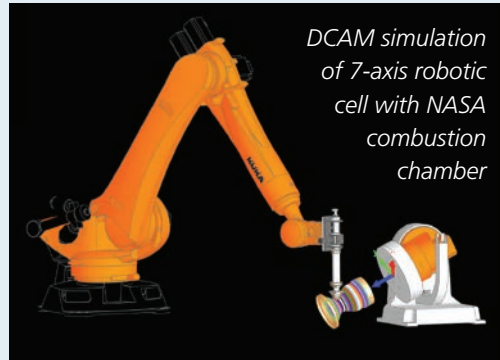


Cross section micrograph showing integrated cooling channels in sidewall of the nozzle build with minimal porosity



Laser DED clad bimetallic combustion chamber

Laser DED process used on NASA combustion chamber



DCAM simulation of 7-axis robotic cell with NASA combustion chamber



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# Transatlantic Collaboration

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## Revolutionizing Sustainability with a Data-Driven Approach with Fraunhofer IPT

In today's competitive landscape, sustainability has become an increasingly important component for companies of all sizes. Beyond global climate commitments like the UN's Sustainable Development Goals, financial institutions, stock exchanges, and the media are placing growing emphasis on sustainability. It encompasses ecological, economic, and social dimensions, and for manufacturing companies, it hinges on reducing energy consumption, CO<sub>2</sub> emissions, resource use, and toxic material substitution.

In 2020, the U.S. ranked second globally in greenhouse gas emissions, with 24% stemming from the industrial sector. Surprisingly, few companies have comprehensive sustainability systems. Transparency issues plague standards and norms, further complicating matters. While Europe prioritizes climate change, the U.S. has only recently joined the fight, allocating substantial funds through the Inflation Reduction Act.

Yet, neither the U.S. nor Europe offers a holistic, data-driven method to assess sustainability maturity in manufacturing. Fraunhofer USA CMA aims to change that. In partnership with the Fraunhofer Institute for Production Technology IPT, we have developed a data-driven sustainability maturity assessment for manufacturing SMEs, enabling benchmarking, identifying sustainability potential, and tailored development plans. An online tool will house standardized criteria, with automatic updates based on evolving standards. We also seek to uncover innovative business models and services for post-research projects.

We target manufacturing SMEs globally, offering progress monitoring, impact assessment, and industry-wide best practice sharing. Societally, this approach promises an evidence-based method to boost sustainability and improve regulation. For Fraunhofer, it means a stronger presence in the U.S. and the opportunity to pioneer new services to one of the largest global markets.

In summary, we're embarking on a transformative journey toward a data-driven sustainability future. It's a journey that promises to empower businesses, revolutionize industries, and lay the foundation for a more sustainable world.



## Systematic AI Image Recognition Testing to Reduce Bias and Improve Decision-Making

In today's world, artificial intelligence (AI) plays an increasingly pivotal role in decision-making processes that impact human lives. However, the stakes are high, and erroneous AI choices can have far-reaching consequences. The challenge lies in ensuring that these AI-based systems can be thoroughly and systematically tested to understand their capabilities and limitations, thus establishing trust in their decision-making abilities. Surprisingly, there has been a lack of end-to-end testing methods and tools tailored to this critical need – until now.

Fraunhofer USA CMA scientists are taking a significant leap forward by introducing a tool-supported testing methodology specifically designed for AI-based systems with Systematic Testing of Artificial Intelligence (AI) Image Recognition, or STAR.

Currently, our focus is on image recognition-based systems, but the principles can extend to other domains. At the heart of our approach is the strategic generation of test images, a process that enhances robustness testing, improves prediction accuracy, and prioritizes test execution. Most notably, it allows for testing even when ground truth labeling is unavailable,

relying on limited information about the AI system under examination.

We're not stopping there. In the pipeline are additional measures to evaluate and quantify the testing process's efficacy and the AI system itself. These measures include assessing adherence to safety-related requirements and gauging the uncertainty inherent in AI-driven decision-making.

The benefits of our systematic testing approach are undeniable. It ensures a consistent testing regimen, eliminating redundancies and inefficiencies. This translates to reduced testing effort and cost, all without compromising the rigor of testing. The ultimate payoff is the development of high-quality AI systems that can be relied upon with confidence. With immediate feature level transformation of faces, instance level transformations, and background weather transformations, our rigorous testing ensures trusted, accurate image identification.

In summary, our pioneering work in AI testing is setting new standards for trust and reliability in AI decision-making. Through innovative testing methods and tools, we are forging a path to a future where AI systems can be trusted implicitly, paving the way for safer, more effective, and dependable AI solutions.





## Growing the EV Market in South Carolina with Soteria

The South Carolina Fraunhofer USA Alliance (SCFUSA) is a collaborative effort between SC Competes, the South Carolina Department of Commerce, and Fraunhofer USA. The alliance was created to advance applied research across the state of South Carolina with Fraunhofer USA and South Carolina research institutions.

In 2022 the South Carolina Fraunhofer USA Alliance Review Board co-funded an applied research project (led by the University of South Carolina and supported by Fraunhofer USA) focused on advancing Greenville-based Soteria Battery Innovation Group's (BIG) effort to improve separator compatibility within Lithium (Li) metal batteries.

Soteria is a technology licensing company that chooses to work with many companies in a consortium-style format. Therefore, a great deal of business development is required as Soteria encourages new businesses to join, evaluate materials, etc. Presently, many businesses focused on Li-metal chemistries can't fully evaluate the separator technology in their products due to the incompatibility. This project addresses this by generating a scientific understanding

of the separator/Li metal incompatibility mechanism to enable a dialogue with these companies. Additionally, the University of South Carolina team has developed two approaches to address the incompatibility challenge. Equally important, however, is the definition of modifications to the manufacturing processes. To this end, the Fraunhofer IPT team engaged in the project to develop recommendations for suitable manufacturing modifications. This transatlantic collaboration resulted in holistic and exceptionally successful project results.

In May 2023, SC Competes hosted the state's first Battery Symposium with presenters from industry, academia and Fraunhofer experts. Soteria BIG's advanced battery safety technology was prominently featured at this inaugural event.

Soteria BIG is a pioneer provider of the non-woven separator for battery applications in the world, and the only one in the U.S. Original development of this technology was to create safer batteries by using a thermally stable separator, which when used in a cell would mitigate thermal runaway by maintaining its shape in the event of a short and prevent catastrophic explosions of the battery.





## Engagement with Fraunhofer Institutes

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Fraunhofer USA continues to jointly represent the entire Fraunhofer-Gesellschaft network and has rapidly proven its institutional value as an expert in the U.S. market. Our joint PACT program continues to exchange personnel and knowledge across the Atlantic to boost the competences of both Fraunhofer USA and Fraunhofer-Gesellschaft scientists. Our continued outreach with Fraunhofer institutes has led to Fraunhofer USA working with nearly 50 of the 76 research institutes in Germany to date, including PACT projects (Personnel/knowledge transfer, competence building), industry projects and other joint developments.

Recent highlights of Fraunhofer USA hosting institutes includes joint panels at Michigan's Integr8 conference with our Automation Alley partners. Focused on Industry 4.0 for SMEs, Integr8 featured Fraunhofer USA president Thomas Schuelke as their morning keynote and hosted three panels with speaking guests from Fraunhofer institutes. Additionally, the South Carolina Fraunhofer USA Alliance hosted a Battery symposium with keynotes from South Carolina Gov. Henry McMaster and Fraunhofer Research Institution for Battery Cell Production FFB's Dr. Christoph Baum, in addition to Fraunhofer guest speakers from five Fraunhofer institutes.

Other collaborations have included webinars with the German Chambers of Commerce Abroad (AHK) and Fraunhofer institutes such as Fraunhofer IPT. We also jointly participated as a community partner during BMW's 2023 Diversity Supplier Xchange.

Future opportunities for exchange also include the research scholar program and Fraunhofer Innovation Mobility program, which permits Fraunhofer-Gesellschaft staff to work in markets such as the U.S. to better understand how we differ in areas such as contract development, project management, and more. Like our namesake, Joseph Von Fraunhofer (portrait left), we continue to innovate and improve, because at Fraunhofer USA, we know how.



## Q&A with Fraunhofer International Mobility program participant Andrea Zeumann

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**Andrea Zeumann is Principal Consultant European and International Funding Programs, Fraunhofer-Gesellschaft**



### *How did you first discover the Fraunhofer International Mobility program and what did you find interesting about it?*

I found the program on the Fraunhofer intranet and that it was open to administrative staff. After receiving several requests from Fraunhofer institutes to participate in U.S. grants, the opportunity arose to apply for the FIM program. In addition, Horizon Europe – a key funding program for research and innovation – offers the possibility for American institutions to apply for grants from the European Commissions which represents a great opportunity to exchange knowledge with American colleagues.

### *What were some of the general lessons learned via your participation in the FIM program?*

If you know each other personally it is much easier to work together in the future, i.e., on joint collaborations. The exchange is easier, although it is important to know the different cultural approaches to a project.

### *After spending time with Fraunhofer USA, what are some of the similarities between us and Fraunhofer-Gesellschaft?*

The first thing I noticed was the structure of Fraunhofer USA Headquarters is like Fraunhofer Germany – only smaller. Through my weekly appointments with my American colleague, who oversees the same field as me – we both noticed again and again how similarly we approach work. We both learned a lot from each other in those meetings. Mutual improvement opportunities were worked out and, most importantly, I now have a direct personal contact at Fraunhofer USA if I have any questions in the future.

### *What are some of the differences?*

I would say the contact frequency and service orientation. For example, Fraunhofer-Gesellschaft may receive a request which is worked on, sometimes for weeks, and when every detail is finished, we send it for review and final approval. In the U.S., there are more milestones to meet and if something doesn't go as planned, it will be redirected and corrected until you get to the same goal. I like that Americans always accentuate the positive. Of course, the big difference is size [there are three Fraunhofer USA centers to Fraunhofer-Gesellschaft's 76+ institutes]. I supervise more than 20 Fraunhofer institutes plus several branch offices in the field of European and U.S. grant application and contract processing and our processes must be very predefined, detailed and applicable to all institutes. I believe that a service orientation is very important, and at Fraunhofer USA, there is a better exchange, interaction, and the service character is much higher, which I liked very much. Contact frequency and technical support leads to a much better relationship between institutes and the headquarters and in addition: the cooperation is much more fun, and one likes to do the job.

### *Would you recommend the FIM program and Fraunhofer USA to other interested parties? Why or why not?*

Yes, I would recommend the FIM Program to other interested parties, but a few requirements would have to be met, such as working on a topic or project for which both institutions can work or benefit from the exchange in the future. Otherwise, a longer stay may not be justified. For administrative staff, this is a little different as we aren't doing direct research work.



***What are some positive cultural interactions you shared with USA personnel, both inside and outside of the working environment?***

I liked the “open door” policy. The doors were open for all colleagues, and I could go to anyone, at any time if I had any questions. They always had an open ear for me and explained many things to me. Before flying to the U.S. I did some research about activities and sights in the area and it was clear to me that Plymouth is not a big city, but a city of 9,000 people. I think this was particularly important, because otherwise I could have felt lonely and bored at the weekends. But if someone is adventurous and open to everything new, it is a wonderful experience. I immediately signed up for a hiking group and a pickleball club and met many nice people with whom I am still in contact today. In addition, I attended all kinds of events in the area and it almost felt like home.

***Would you participate in the FIM program again and do you think the time you spent was valuable and sufficient?***

I would take part in the FIM Program again. I learned so much professionally in working together and getting to know incredibly nice people. The period of four months was perfect for me, because in addition to the exchange, I sometimes was also able to support colleagues in their everyday work through my knowledge of other Fraunhofer contacts at Fraunhofer headquarters.

***Any other comments you would like to add?***

I had one of my most interesting moments when I was able to take part in a guided tour of the Fraunhofer USA CMW, in East Lansing, Mich. In my almost 25 years at Fraunhofer I attended many good and interesting institute tours at Fraunhofer, but never one which was explained so enthusiastically, easy to understand and with the Fraunhofer vision:

“Yes, we can” and “We are the best”.

As I drove back from East Lansing to Plymouth and thought about the tour, a thought flashed through my head and I smiled proudly: “Yeah, I work for Fraunhofer.”



“If you know each other personally it is much easier to work together in the future, i.e., on joint collaborations. The exchange is easier, although it is important to know the different cultural approaches to a project.”



## Outlook

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As we venture into the future, the global landscape of innovation and industry is rapidly evolving, marked by profound shifts in technology, business models, and international partnerships.

The global economy is more interconnected than ever before, and transatlantic collaboration remains a cornerstone of international innovation. As the United States and Europe seek to strengthen their economic ties, we can expect an upsurge in cooperative ventures that leverage the complementary strengths of these two major regions. We anticipate intensified collaboration in fields such as clean energy, biotechnology, and aerospace. Joint research initiatives and knowledge sharing will be crucial in addressing global challenges, including climate change and public health crises.

Technology transfer is poised for a transformative era in the coming years. Emerging technologies like artificial intelligence, quantum computing, and advanced materials hold tremendous potential, and the race to harness their power is on. To expedite this transfer, governments and institutions will need to streamline regulatory processes, create incentives for private-sector investment, and establish robust intellectual property frameworks. The democratization of innovation will become a central theme, with open-source initiatives and global innovation networks playing pivotal roles.

Industry 4.0, characterized by the fusion of digital technologies with traditional manufacturing, presents both opportunities and challenges. While it promises increased efficiency, sustainability, and customization, it also raises concerns about job displacement and cybersecurity. Striking a balance between automation and

human labor, along with fortifying digital infrastructures against cyber threats, will be paramount. Cross-border collaboration in establishing standards, norms, and best practices for Industry 4.0 implementation will help address these challenges and create a more inclusive and secure future for industries on both sides of the Atlantic.

Fraunhofer USA, an integral part of the global Fraunhofer-Gesellschaft network of innovation and applied research, can play a pivotal role in shaping the future of transatlantic collaboration and technology transfer. As a bridge between Europe and the U.S., Fraunhofer USA facilitates the exchange of knowledge, technologies, and best practices. Its expertise spans a wide range of industries, from advanced manufacturing and materials science to renewable energy and information technology. We can anticipate Fraunhofer USA continuing its position as a leader in promoting joint research endeavors, technology commercialization, and talent exchange.

The future promises a dynamic landscape of opportunities and challenges driven by transatlantic collaboration, technology transfer, Industry 4.0 advancements, and organizations like ours, aimed at furthering societal improvement for all stakeholders. To harness this potential, we all must foster a culture of innovation, embrace open collaboration, and prioritize responsible and sustainable technological development. As we embark on this journey, it is essential to remember that by working together, the United States and Europe can lead the way in shaping a brighter, more interconnected, and technologically advanced future for all.

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# Fraunhofer USA Partners and Memberships

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## American National Standards Institute (ANSI)

Fraunhofer USA is a member of ANSI and supports interests of the Fraunhofer-Network in standardization matters in the United States.

## Automation Alley

Automation Alley is a World Economic Forum Advanced Manufacturing Hub (AMHUB) and a nonprofit Industry 4.0 knowledge center with a global outlook and a regional focus. Based in Michigan, Automation Alley is very well connected to manufacturing companies throughout the midwestern U.S. providing its more than 1,400 members the knowledge necessary to adopt new Industry 4.0 technologies. Fraunhofer USA technical experts will have the opportunity to present new technologies to the members of Automation Alley through seminars, presentations, and at their yearly international conference Integr8.

## Association of University Research Parks

The Association of University Research Parks (AURP) is the United States' leading organization of universities, municipalities, federal labs, and corporations. It brings together this diverse group of members to foster communities of innovation that provide society with jobs, resources, and technologies. This aligns very well with the Fraunhofer mission to create a better, stronger society through technology. Fraunhofer USA will use the AURP network to help grow the Alliance Program as well as build new relationships with universities and corporations.



## German American Chamber of Commerce

Fraunhofer USA is a National Partner of the German American Chamber of Commerce (GACC). The GACC is part of a global network of German Chambers of Commerce Abroad (AHKs) which has 140 offices in 92 countries. In the U.S., more than 2,500 German companies maintain memberships with the GACC. The GACC assists with increasing the awareness of Fraunhofer's presence within the U.S. as well as providing visiting German delegations opportunities to meet with Fraunhofer USA experts.

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