U.S. NATIONAL SCIENCE FOUNDATION
2415 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22314

NSF 24-043

Dear Colleague Letter: Funding Opportunities for Engineering Research in Emerging Areas of Advanced Manufacturing

December 22, 2023

Dear Colleague:

With this Dear Colleague Letter, the U.S. National Science Foundation (NSF) Directorate for Engineering (ENG) encourages the submission of research and education proposals related to **Advanced Manufacturing as an Emerging Industry**.

Manufacturing is essential to almost every sector of the U.S. economy, spurring growth by increasing productivity, enabling new products, and opening new industries. The NSF and Engineering Directorate investment in advanced manufacturing will continue to grow our nation's workforce, enhance supply chain resilience, and create products and processes with higher performance, fewer resources, and/or new capabilities.

Research in emerging areas of Advanced Manufacturing will accelerate breakthroughs in manufacturing materials, technologies, and systems through fundamental, multidisciplinary research that transforms manufacturing capabilities, methods, and practices. NSF and Engineering Directorate investments will spur manufacturing breakthroughs in advanced energy- and resource-efficient industrial technologies, resilient manufacturing strategies, novel methods in engineering biology, next-generation materials, and the power of data science, automation, robotics, and machine learning to intelligently design and develop future approaches that are secure, sustainable, and resilient to natural and anthropogenic disasters.

NSF and the Engineering Directorate invest in research and education activities in emerging advanced manufacturing technologies that align with the needs of the nation and support the CHIPS and Science Act of 2022, White House strategies (such as the 2023 *Executive Order on Federal Research and Development in Support of Domestic Manufacturing and United States Jobs*), and other policy directives, including the National Science and Technology Council's 2022 *National Strategy for Advanced Manufacturing*, to grow the Nation's economy, create quality jobs, enhance environmental sustainability, address climate change, strengthen supply chains, ensure national security, and improve healthcare.

ENGINEERING DIRECTORATE INTERESTS

The Directorate for Engineering encourages the submission of all types of research and education proposals related to emerging areas of advanced manufacturing, including proposals in the following areas:

Human-Machine Interaction: Human-machine co-adaptation and/or collaboration implementing sensorimotor interaction to achieve new capabilities in specific manufacturing tasks.

Biomanufacturing using cells and cellular components: Understanding mechanisms of cell differentiation to enhance biomanufacturing, leading to novel products, biomaterials, and significant improvements in individualized medicine, environmental control and monitoring and adaptive sensing.

Tissue biomanufacturing: Understanding mechanisms and design rules for manufacturing three-dimensional tissues, organs, and organoids; development of validated and reproducible models (in vitro or in silico) of healthy and pathological tissues and organ systems.

Cyber manufacturing and systems integration: Realizing smart, secure, and integrated digital manufacturing systems within the larger life cycle ecosystem through advances in digital representation, protocols, and processes for collaboration (machines and/or humans); intelligent self-organizing production systems; interoperability and seamless integration; and reliable and resilient manufacturing systems; and other areas.

Autonomous systems and robots: Integrating engineering disciplines such as control systems and mechanical systems with artificial intelligence (AI) and machine learning, for applications such as transportation, manufacturing, healthcare, and safe human-robot teaming in manufacturing and supply chain settings.

Computational and AI models of physiological systems: Advancing computational strategies that leverage AI and machine learning to develop validated models of physiological systems; computational representations of biomanufacturing processes for precision monitoring and control.

Eco manufacturing: Investigating novel designs, manufacturing processes, and systems that reduce the environmental impact of manufacturing, including efficient use of energy, electrification of industrial processes, waste reduction, re-manufacturing, recycling, reduction in harmful chemical usage, and processes that avoid the use of critical materials.

Environmentally sustainable manufacture of semiconductors: Developing new semiconductor manufacturing processes that reduce or preferably eliminate the use of per- and polyfluoroalkyl substances (PFAS).

Semiconductor and electronics manufacturing processes: Understanding novel reactor designs, such as chemical vapor and atomic layer deposition systems; manufacturing techniques for advanced packages that approach on-chip interconnect density and handle challenges of power density, integration, and assembly; integration of semiconductors with quantum devices and systems.

Nanomanufacturing: Developing innovative manufacturing techniques that enable manufacturing of quantum devices and integrated systems to advance manufacturing repeatability and system scalability.

Scalable design, planning and control of manufacturing systems and supply chains: Developing scalable data-driven and model-drivel approaches to the planning, design and control of large-scale, resilient and effective manufacturing systems and supply chains.

Additive manufacturing for civil infrastructure: Investigating large-scale additive manufacturing of novel infrastructure materials with reduced lifecycle carbon footprint and multi-functional behavior.

PROGRAMS AND CONTACTS

The Engineering Directorate encourages the submission of proposals related to advanced manufacturing to the ENG core programs listed below, and to other relevant programs. To determine which program best fits a project idea, Principal Investigators are encouraged to read the program descriptions and reach out to program contacts with questions.

- Advanced Manufacturing: AdvancedManufacturing@nsf.gov
- Communications, Circuits, and Sensing-Systems: Rosa (Ale) Lukaszew, rlukasze@nsf.gov
- Dynamics, Control, and Systems Diagnostics: Yue Wang, yuewang@nsf.gov
- Engineering Design and Systems Engineering: Kathryn Jablokow, kjabloko@nsf.gov
- Engineering for Civil Infrastructure: ECI@nsf.gov
- Engineering of Biomedical Systems: Stephanie George, stgeorge@nsf.gov
- Environmental Engineering: Mamadou Diallo, mdiallo@nsf.gov; Karl Rockne, krockne@nsf.gov
- Environmental Sustainability: Bruce K. Hamilton, bhamilto@nsf.gov
- Foundational Research in Robotics: Jordan Berg, jberg@nsf.gov
- Manufacturing Systems Integration: Janis P. Terpenny, jterpenn@nsf.gov
- Mechanics of Materials and Structures: moms@nsf.gov
- Mind, Machine and Motor Nexus: Alex Leonessa, aleoness@nsf.gov; Alexandra Medina-Borja, amedinab@nsf.gov
- Operations Engineering: Georgia-Ann Klutke, gaklutke@nsf.gov; Reha Uzsoy ruzsoy@nsf.gov

Process Systems, Reaction Engineering, and Molecular Thermodynamics: Raymond A. Adomaitis, radomait@nsf.gov

The Engineering Directorate also encourages proposals for research centers, which tackle grand challenges and spur industrial innovation, and for workforce development, which provides experiential learning opportunities and opens new career paths.

- Engineering Research Centers (ERC): nsferc@nsf.gov
- Industry–University Cooperative Research Centers (IUCRC): Prakash Balan, pbalan@nsf.gov
- Non-Academic Research Internships for Graduate Students (INTERN): Prakash Balan, pbalan@nsf.gov
- Research Experiences for Teachers (RET): Amelia Greer, agreer@nsf.gov
- Research Experiences for Undergraduates (REU): reu.eng@nsf.gov (REU for ERCs: reu.eng.erc@nsf.gov)

SUBMISSION GUIDANCE

Proposals submitted in response to this DCL should focus on scientific research and education relevant to the emerging areas of advanced manufacturing. Proposal titles should begin with **"ENG-EAM:"** followed by any other relevant prefixes and the project name.

For consideration during fiscal year 2024, proposals to programs without deadlines should be submitted by April 30, 2024; proposals submitted later will be considered for fiscal year 2025.

NSF welcomes proposals that broaden geographic and demographic participation to engage the full spectrum of diverse talent in STEM. Proposals from minority-serving institutions, emerging research institutions, primarily undergraduate institutions, two-year colleges, and institutions in EPSCoR-eligible jurisdictions, along with collaborations between these institutions and those in non-EPSCoR jurisdictions, are encouraged.

This DCL does not constitute a new competition or program. Proposals submitted in response to this DCL should be prepared and submitted in accordance with guidelines in the NSF Proposal & Award Policies & Procedures Guide (PAPPG) and instructions found in relevant program descriptions.

Sincerely,

Susan Margulies
Assistant Director, Engineering