



## Minority University Research and Education Project (MUREP)

**Institution:** University of Illinois, Chicago

**Award Name:** MUREP Institutional Research Opportunity (MIRO) - Group 8

**Award Number:** 80NSSC24M0176

**Title:** Center for In-Space Manufacturing (CISM-R2): Recycling and Regolith Processing

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**Award Fiscal Year:** 2024

**Summary:** NASA's In-Space Manufacturing (ISM) seeks to develop the materials, processes, and manufacturing technologies needed to provide an on-demand manufacturing capability for deep space exploration missions. In-Space recycling and in-situ resources utilization are critical to the ISM mission as they enable a broad range of in-space services and sustainable development. In this context, the objectives of this proposed project are to:

- 1) establish a Center for In-Space Manufacturing- Recycling and Regolith Processing (CISM-R2), a prominent engineering research center at UIC, specializing in the advancement of ISM techniques for recycling and regolith utilization;
- 2) enhance and sustain UIC's research and education capability in NASA-related areas, and
- 3) increase the number of UIC students engaged in NASA-related areas, promoting the inclusion of underrepresented and low-income students.

We propose to partner with NASA Marshall Space Flight Center (MSFC), Northwestern University (NU) and Northern Illinois University (NIU). The collaborative effort extends to government/industry/society organizations including DOE Argonne National Laboratory (ANL), Chicago mHUB, and The American Society for Nondestructive Testing (ASNT).

We will leverage MSFC's expertise in ISM, NU's expertise in engineering design, and NIU's expertise in hybrid manufacturing, to build the proposed CISM-R2 research programs through creating six research thrusts: (T1) Discover Recycled/Regolith-based Composites (R Composites) for In-Space Manufacturing; (T2) Establish Architected R Composite Design Science; (T3) In-Space Manufacturing of Architected R Composites; (T4) Characterizations and Non-destructive Evaluations; (T5) Multi-modal Data Analysis and Material-Architecture-Process Co-design; and (T6) Life-cycle Assessment and Sustainability Evaluations of ISM Technologies. The proposed research activities will directly support the Materials Science research priority of NASA's Science Mission Directorate, aligning with the TX07.1 In-Situ Resource Utilization, the TX07.2.2 In-Situ Manufacturing, Maintenance, and Repair, and the TX12 Materials, Structures, Mechanical Systems, and Manufacturing, as listed in the 2020 NASA Technology Taxonomy report. Within these research thrusts, every year, eleven students will be actively involved and trained as research assistants, and approximately 20 underrepresented low-income undergraduate students will be recruited and involved as hourly-paid research assistants. They will be trained on equipment, methodology, simulation software, programming, algorithms, and experimentations. In addition, these research activities will generate teaching materials and offer course project subjects to enrich the curricula of mechanical, industrial, civil, materials, and environmental engineering programs at UIC.

To further enhance UIC's educational capacity and increase the number of UIC students engaged in NASA related fields, we propose to: (1) Create and continuously improve CISM-R2 curricula; (2) Establish a CISM-R2 certificate program, assistantships, and internships. Students will have opportunities to earn course credits, receive CISM-R2 program certificates, benefit from joint mentorship, take on roles as teaching and research assistants, and be selected as awardees for NASA internships; and (3) Perform various outreach activities, organize summer workshop and MSFC visits. The outreach activities will expose NASA learning opportunities to >1000 High School students with a majority from the underrepresented and low-income groups.

Through this project, we will reinforce partnerships with NASA MSFC, NU, NIU, mHUB, ANL, and ASNT. The proposed research, education, and outreach efforts are expected to significantly advance the science and technology in alignment with NASA research priorities, build UIC's research and education capacity, and contribute to the development of a diverse and skilled workforce for NASA-related fields.