

Title: Increasing NTU Institutional Capacity: Additive Manufacturing and Materials Research and Education for NASA Applications

Institution: Navajo Technical College

City/State: Crownpoint, New Mexico

PI: Monsuru Ramoni

Summary: Increasing Navajo Technical University Institutional Capacity: Additive Manufacturing and Materials Research and Education for NASA Applications is a proposed collaboration between lead institution Navajo Technical University (NTU), the Marshall Space Flight Center Advanced Manufacturing Center (MSFC) and University of Alabama Huntsville (UAH) to conduct additive manufacturing research around directed energy deposition (DED) of bi-metallic parts for NASA applications and build institutional capacity in STEM research and education. Project goals and objectives revolve around strengthening and developing NTU's research capacity and infrastructure in STEM areas of strategic importance and value to NASA—advanced manufacturing and metal additive manufacturing, more specifically—and focus on conducting relevant research in additive manufacturing, building strategic partnerships with the academy, industry and government agencies, strengthening the capacity of NTU faculty and students, and increasing the number of American Indians who graduate with STEM degrees.

The proposed research project involves additive manufacturing (AM) of Inconel-copper (Cu) alloy bi-metallic parts and is closely aligned with the NASA's Human Exploration and Operation Mission Directorate's Space Launch System—an advanced launch vehicle for a new era of exploration beyond Earth's orbit into deep space. The proposed research will conduct characterization (micro and nano-scale) of the microstructure of AM Inconel-Cu alloy bi-metallic parts in three conditions: (i) as received, (ii) hot-isostatic pressing and heat treatment, and (iii) after a combined hot-isostatic pressing and heat treatment (iv) metrology of DED Inconel-Cu alloy bimetallic parts in order to establish the necessary linkages between microstructure, post-processing and mechanical properties. The research findings will provide a better understanding of microstructural formations and their effects on the mechanical properties, tensile strength, hardness, toughness, fatigue strength, reduction of area, etc., of DED Inconel-Cu alloy bi-metallic parts post-heat treatment and hot-isostatic pressing. This fundamental knowledge will help MSFC develop advanced parts for use in the Space Launch System that open new possibilities for further space exploration and significantly reduce manufacturing costs and time.

The proposed project will strengthen the research and education capacity of NTU faculty and students. Faculty will build capacity through professional development and collaborative research opportunities with MSFC for contribution to NASA's Space Launch System Mission and UAH for building an institutional culture of research. The project offers six NTU American Indian students enrolled in four-year engineering programs the opportunity to participate as research assistants in an intensive and comprehensive three-year research project in AM for NASA applications; acquire experience in NASA applications in a one-year paid internship with MSFC; and take up to six credits in classes relevant to their field of study at nearby UAH.

NTU will create and integrate modules based on the proposed research with NASA applications into NTU engineering course curricula, thereby reaching even more American Indian students with education around NASA's mission, STEM applications, and possible career paths. In addition, the proposed MIRO project supports the development of a STEM K-12 pipelines to expose younger American Indian students to STEM and STEM career pathways, with an emphasis on NASA applications. As a role model for TCUs in building advanced manufacturing capabilities, NTU will continue to work with other TCUs to offer training and workshops in the areas of metrology, 3D printing and other AM technologies enabled by this proposal. In these ways, the proposed MIRO project is working to increase the number of American Indians who graduate with STEM degrees and enter the workforce.