Simulating Nuclear Radiation Environments and Testing Capabilities for Electronics

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Program: [GSI]

Abstract: This proposal outlines the establishment of a crucial component within the DOE General Scientific Infrastructure (GSI) support framework. The primary objective is to develop an advanced capability for simulating and studying extreme environments with elevated radiation dose and high-temperature conditions similar to that in nuclear facilities. Besides, this proposal aims to empower research and training endeavors focused on both radiation hardened and high temperature durable micro/nanoscale electronics, particularly in the context of extreme environments. This effort is directly aligned with the emerging field of nuclear science and engineering (NS&E) research and education at The University of Central Florida (UCF).

The proposed equipment includes a range of cutting-edge technologies. This includes a high power, versatile X-ray and γ-ray radiation source with unable energy. Additionally, an external radiation dose calibration sensor/monitor and an innovative environmental chamber will be incorporated into the infrastructure. The environmental chamber offers precise control over critical parameters such as pressure, gaseous composition, and humidity. We will integrate the equipment with an existing miniaturized high-temperature probe station at UCF. The probe station is designed to facilitate the elevation of sample temperatures from room temperature to 1000°C. By merging this high-temperature capability with the radiation and environmental control features, a comprehensive testing and characterization system will be established. This integrated system will be used to simulate conditions for extreme environments in core components of nuclear facilities. In essence, this proposed system will greatly advance the capabilities of the university's budding NS&E program. By creating a cutting-edge experimental platform for elevated radiation and high-temperature environments, the proposed infrastructure will greatly contribute to micro/nanoscale electronics research and training. Ultimately, this endeavor aligns with the institution's vision of fostering innovation and expertise in the realm of extreme environment studies.

The GSI support will provide significant impacts on workforce and technology development that can help grant the United States a leading edge in several important emerging NS&E applications. For education and training, the equipment' implementation and propose activities will offer hands-on training in microsystems post-processing and characterization under extreme conditions, benefiting UCF's diverse minority student body. This prepares them for nuclear career paths within DOE-NE. Further, training on DOE-NE relevant equipment enhances STEM career prospects and bolsters the STEM graduate pipeline for nuclear science and engineering (NSE) skills. In fundamental research, the equipment's outcomes will directly influence understanding of materials, device physics, high-temperature & radiation effects, high-performance electronics, MEMS, and pioneering packaging techniques. Further, it helps to technological boost for industry. The initiative will stimulate NS&E device development, encouraging researchers and manufacturers to create more advanced instruments with improved performance. This contributes to the growing manufacturing industry, particularly in regions like Florida, generating new high-tech job opportunities.