Fuel Fabrication Line for Advanced Reactor Fuel Research, Development and Testing

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Collaborators: Name – Organization *[N/A if none]*

Program: General Scientific Infrastructure

ABSTRACT:

The University of Texas at San Antonio (UTSA) proposes to expand the existing fuel fabrication capability of its Extreme Environments Materials Laboratory, (EEML, ***PI: Dr. Elizabeth Sooby)*** to include a glovebox fuel fabrication line, (four work stations with a total of 2.8 m_2 of work space), with an integrated, refractory furnace capable of sintering monolithic fuel samples and other relevant reactor ceramics at temperatures in excess of 2000°C. The proposed capability will be customized with design focus on the production of advanced and conventional uranium-bearing fuel samples, specifically UC, UN, U_3Si_2, their composites, and doped fuels, of uniform geometry (pellets) with high density (>90% theoretical density) for future collaborative proposals in support of the DOE-NE and NSUF missions. The EEML is an 1140 sq. ft. radiological space dedicated to the synthesis, testing, and characterization of uranium bearing fuels and advanced reactor structural materials. The facility has license to work with up to 1.5 kg of depleted uranium (dU: a common isotopic surrogate used to investigate chemical and thermal behavior fuel forms) as well as the space and facilities necessary to house the proposed capability. The existing arc melt furnace capability, 11kW chiller, powder metallurgical equipment and established fuel fabrication expertise will be leveraged to produce dense, uniform geometry samples in the glovebox fabrication line proposed. These dU-bearing samples are ideal to support and enable a number of experimental efforts, including but not limited to the following objectives:

- Investigations of fabricability of advanced fuel forms and composites
- In-pile testing of advanced fuel chemistries, to be leveraged in future NSUF applications
- Thermal analysis assessments of thermal stability of advanced fuels and composites
- Fuel-cladding chemical and mechanical interaction
- Production of sim-fuel samples (nitrides, carbides, and silicides)

UTSA is willing and eager to become part of the NSUF program, welcoming collaborative work with outside institutions to produce samples for a broader set of interest, whether that be rapid turn-around experiments proposals for irradiation investigations, ion irradiation campaigns, to probe the structure of these compounds using advanced diffraction methods, etc. The **outcome** of the proposed program will be the commissioning of a state-of-the-art sample fabrication facility, capable of producing dU-bearing monolithic specimens to be employed at UTSA and collaborating institutions in testing, analysis, and characterization relevant to the advancement of reactor fuel technology. A barrier to fundamental fuels characterization and testing is often supply of fuel samples, which is an expensive endeavor in a national laboratory setting, where currently the most productive and prolific R&D fuel fabrication capabilities are housed. The fabrication capability proposed will be one of very few in existence in a university setting (there are only two in the country, that the PI is aware of, with this level of sintering capability paired with the approval to handle large quantities of uranium), making it more accessible, in both facility access and cost, to students and researchers than those within the national laboratory complex. Finally, the capability will be leveraged in future work at UTSA and its collaborating institutions to advance the state of knowledge and bridge data gaps in uranium compounds, alloys, and composites.