DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory

CX Posting No.: DOE-ID-INL-20-037

SECTION A. Project Title: INL Support for Development of a Fast Gas Delivery System

SECTION B. Project Description and Purpose:

Mithra Technologies, Inc. agrees to support INL researchers working in the Catalysis and Transient Kinetics Laboratory to provide development and testing services associated with the SBIR award, *Developing a Fast Gas Delivery System for Transient Spectrokinetic Measurements*. This award is focused on a new approach to combine detailed transient kinetic experiments with advanced spectroscopic characterization of catalytic materials. Development of a fast gas delivery system will enable transient spectrokinetic measurements that can provide researchers with new fundamental understanding of how the structure and composition of complex industrial catalysts can be manipulated to improve the energy efficiency of chemical reactions.

INL specializes in catalyst characterization using the TAP (Temporal Analysis of Products) transient kinetic characterization tool; the fast gas delivery system will be based on this design. Mithra is the original manufacturer of the TAP reactor system but does not have a complete system needed for testing/diagnostic purposes as needed for execution of the work scope associated with the SBIR award.

The main purpose of this work is to support development and testing activities associated with the SBIR award. A compact gas pulsing manifold will be developed by Mithra in collaboration with INL. Following design and fabrication, Mithra will rely on INL to asses pulse intensity, stability and reproducibility specifications as required for successful integration of the unit into a laboratory-scale XPS (X-ray photoelectron spectrometer) located at Brookhaven National Laboratory (BNL).

INL will provide consulting support on the subject of TAP pulse response experimental characteristics for successful integration of a fast gas delivery system into a laboratory scale XPS instrument. INL will make necessary adjustments to INL's TAP reactor system (Energy Innovation Laboratory C111) in order to accommodate testing of the prototype manifold which is expected to require significant height clearance from where the existing reactor and valve manifold currently sit. The manifold will be designed to pulse directly into the mass spectrometer ionizer. INL will determine if the time-resolution of the existing mass spectrometer data acquisition system is sufficient to capture the fast transient; if not, a particle holder will be fabricated to accommodate a small packed bed. This will slow the transport down so that the pulse stability and reproducibility can be more readily assessed using the methods conventional to TAP. The packed bed would only be used for testing purposes and is not intended to be used in conjunction with spectroscopic experiments. INL will provide a written report of findings and work together with Mithra to make any refinements to the valve design.

With INL's long experience in building TAP pulse valves, INL will provide clear communication to Mithra for the recommended design adjustments that might otherwise require extensive trips back and forth between Idaho and Missouri to design, test and refine. INL will work with Mithra to meet the valve performance specification on successive design iterations. Once successful, the design will be finalized, and second valve will be fabricated to complete the manifold. INL has specified that while refinements are being made at Mithra's facility, the testing system be straightforward to remove such that INL can continue with TAP experiments in the interim.

Task No.	Tasks	Contractor Role/Responsibilities	Sponsor Role/Responsibilities
1	**Design.** Complete design and dimensioned CAD drawings for prototype two-valve manifold construction. Confirm device can dimensionally integrate into XPS system without interference from other spectroscopy hardware.	Provide consulting support.	Complete design and dimensioned CAD drawings.
2	**Fabricate housing.** Complete valve manifold housing on 2.75" conflat feedthrough. Demonstrate vacuum integrity (10^{-8} cc·sec/atm He) of housing.	Provide consulting support.	Fabricate housing and demonstrate vacuum integrity
3	**Fabricate valve.** Complete first iteration prototype valve (quantity 1) and test pulse characteristics on He leak detector. Demonstrate He leak rate < 10^{-8} cc·sec/atm, coarse pulsing stability > 10,000 cycles.	Provide consulting support.	Fabricate prototype valve and demonstrate vacuum integrity
4	**Fabricate adapter flange.** Complete adapter flange for integration with INL TAP reactor system.	Fabricate adapter flange.	Provide any updates to CAD drawings
5	**Test.** Ship manifold housing and prototype valve to INL for testing. Use INL pulse circuitry and software for control.	Make, adapter flange, pulse circuitry and control system available.	Ship manifold housing and valve prototype.
6	**Test & Refine.** Capture initial performance characteristics (pulse width, stability, reproducibility, etc.) of first iteration prototype and modify design as needed.	Capture performance characteristics and provide any recommendation for design modification.	Provide consulting support.
7	**Test & Refine.** Complete testing & refinement cycle. Demonstrate independent pulsing of 2 valves.	Complete testing and prepare report for valve performance.	Provide consulting support.
8	**Fabricate Software and Independent Control System.** Complete circuitry, computer interface and software control system. Ship to INL for testing with valve system.	Provide consulting support.	Develop software and fabricate control system.
9	**Test new software and independent control system.**	Test new software/control system with prototype. Provide any recommendation for modifications.	Provide consulting support.

Task No.	Tasks	Contractor Role/Responsibilities	Sponsor Role/Responsibilities
10	**Ship all components to BNL for final phase of testing**	Packaging and shipping.	None
11	**Demonstrate.** Pulse argon at 10 nmol intensity and demonstrate safe vacuum operation for the HV detector. Determine upper range for pulse intensity.	Provide consulting support.	Demonstrate operation in collaboration with BNL

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

Regulated air emissions from this work include carbon monoxide, carbon dioxide, methane, oxygen, nitrogen, and argon. These potential emissions would be covered by the existing APAD for EIL (APAD INL-13-007).

Discharging to Surface-, Storm-, or Ground Water

N/A

Disturbing Cultural or Biological Resources

N/A

Generating and Managing Waste

Industrial wastes include common lab waste such as personal protective equipment (PPE), wipes, and lab washwater. Water discharged to the Idaho Falls Sewer system will meet sewer discharge limits. No hazardous waste generation is anticipated.

All solid waste will be managed by Waste Generator Services.

Releasing Contaminants

Although not anticipated, there is a potential for spills when using chemicals or fueling equipment. In the event of a spill, notify facility environmental staff. If environmental staff cannot be contacted, report the release to the Spill Notification Team (208-241-6400). Clean up the spill and turn over spill cleanup materials to WGS.

Using, Reusing, and Conserving Natural Resources

The proposed action has the potential to generate materials that can be recycled. Project personnel will work with EIL personnel to recycle, reuse, and recover materials wherever possible.

SECTION D. Determine Recommended Level of Environmental Review, Identify Reference(s), and State Justification: Identify the applicable categorical exclusion from 10 Code of Federal Regulation (CFR) 1021, Appendix B, give the appropriate justification, and the approval date.

For Categorical Exclusions (CXs), the proposed action must not: (1) threaten a violation of applicable statutory, regulatory, or permit requirements for environmental, safety, and health, or similar requirements of Department of Energy (DOE) or Executive Orders; (2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment or facilities; (3) disturb hazardous substances, pollutants, contaminants, or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; (4) have the potential to cause significant impacts on environmentally sensitive resources (see 10 CFR 1021). In addition, no extraordinary circumstances related to the proposal exist that would affect the significance of the action. In addition, the action is not "connected" to other action actions (40 CFR 1508.25(a)(1) and is not related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1608.27(b)(7)).

References: 10 CFR 1021, Appendix B, B3.6, "Small-scale research and development, laboratory operations, and pilot projects"
Justification: The proposed R&D activities are consistent with CX B3.6 "Siting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed area (where active utilities and currently used roads are readily accessible). Not included in this category are demonstration actions, meaning actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial deployment;"

Is the project funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act) ☐ Yes ☒ No

Approved by Jason Sturm, DOE-ID NEPA Compliance Officer on: 5/28/2020