11-09-23

Materials Characterization Requests
Master Scope of Work- MSW-01-FY-23
Ames National Laboratory

Background

Ames National Laboratory possesses capabilities and expertise to provide holistic imaging studies and physical and magnetic property measurements along with comprehensive data analysis and interpretation on a wide range of metallic, magnetic and intermetallic compounds and critical materials. The Laboratory is specifically expert in its scientific understanding of materials containing rare earth elements, permanent magnets, quantum materials, device characterization, alloys for energy applications, and conductors/superconductors. This expertise is rooted in decades of world-leading science that is not available in the private sector. As the focus of industry grows in the area of developing materials and processes for developing US supply chains and alternatives to permanent magnets and other critical materials, the Laboratory is increasingly receiving requests from the private sector to provide holistic materials characterization and expert analysis of data/results, especially as many small businesses do not have large R&D departments and/or limited research capabilities. These services typically require the rapid placement and turnaround that would benefit from the speed and agility the Master Scope of Work (MSW) affords.

Mission Relevance

The technologies that will be developed and deployed in these collaborations are directly relevant to DOE research interests and based on core capabilities funded under SC and EERE. For example, efforts to develop new critical-element-free permanent magnets substantially advance EERE and ARPA-E research to develop and deploy US-based solutions for permanent magnets that are key to increasing electrification of the economy. The capabilities deployed and collaborations developed in this MSW will complement the research funded by SC and the Ames-led Critical Materials Innovation Hub (EERE).

Task Category I: Microscopy

The Laboratory's Sensitive Instrument Facility houses current and next-generation characterization instruments. This uniquely constructed space enables the study of structure and chemistry at the atomic scale by isolating instruments from thermal, vibration, and electromagnetic interference. Unique details include two-feet thick concrete floors with built-in vibration dampening layers, aluminum-plate lined bays, and fiberglass reinforced concrete for electro-magnetic isolation, and vibration-free heating and ventilation. These features help ensure the instrumentation achieves the highest possible resolution.

Tasks in this category include:

- Electron Microscopy
- Transmission Electron Microscopy (TEM) sample prep by microtome or low energy focused ion beam (FIB)
- Diffraction contrast TEM imaging
- Elemental mapping using energy dispersive X-ray spectroscopy

- Electron energy loss spectroscopy and magnetic domain imaging with Lorentz microscope
- Optical Microscopy (e.g., Terahertz, Raman, luminescence, high spatial resolution)
- Data analysis and interpretation of results

Task Category II: Physical, Chemical, and Magnetic Property Measurement
Tasks in this category include:

- Thermal analysis including differential scanning calorimetry and thermal gravimetric analysis
- Phase and crystal structure determination using scattering techniques such as X-ray diffraction
- Chemical analysis including X-ray fluorescence, inductively coupled plasma-optical emission spectroscopy
- Physical and magnetic property measurements such as thermal conductivity, magnetometry, Curie Temperature, Magnetic Remanence, specific heat, electrical resistivity
- Mechanical property measurements on bulk materials and surfaces, such as strength, hardness, tribological over a range of temperatures and atmospheres
- Data analysis and interpretation of results

Task Category III: Solid-state nuclear magnetic resonance (NMR) spectroscopy
This facility supports Ames National Laboratory research across divisions and is equipped to carry out nearly any solid-state NMR experiment imaginable. Solid-state NMR experiments can be performed under multi-extreme conditions of ultra-low temperatures, high pressures, and high magnetic fields.

Tasks in this category include:

- Ultrafast magic-angle spinning (MAS)
- Dynamic nuclear polarization
- Mixed phase high-pressure in situ MAS NMR
- Ultra-low temperature NMR

Restrictions for this MSW
Work involving human or animal subjects, and work requested by any sponsor that has foreign ownership control or influence, will not be eligible to be performed under this MSW. All work performed under this MSW will be subject to all AMES rules, regulations, and procedures.

Each project under this MSW will be reviewed by the cognizant Division Director, the Innovation Partnership Program staff and other appropriate subject matter experts prior to proceeding with an action.