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Opportunity Title: AI Guided Multiphysics and Multi-Scale Modeling of Microwave-Based Conversion Systems for the Valorization of Methane
Opportunity Reference Code: NETL-FRP-2024-Haynes

Organization National Energy Technology Laboratory (NETL)

Reference Code NETL-FRP-2024-Haynes

How to Apply A complete application consists of:

- An application, including academic history, work history experiences, and honors/awards
- A current resume/CV, including academic history, employment history, relevant experiences, and publication list
- Two educational or professional recommendations
  You must provide contact information for at least two recommenders in your application. The first two recommendations received will be attached to your application for review by NETL. You may click the "send" (paper airplane) button to send the recommendation request email immediately after entering their information prior to submitting your application; if not, a request will automatically be sent when you submit your application. Your recommenders will receive an email with a subject line of "[Your Name] - ORISE Recommendation Request - [your email]", from Zintellect@orau.org. This email will include information on the opportunity to which you have applied, as well as a secure link to submit a recommendation for you for this application. If you ask the same person to submit a recommendation for you for multiple applications in Zintellect, they must click the unique link in each email request, but will be given the opportunity to copy over what they had previously submitted.

All documents must be in English or include an official English translation.

If you have questions about the application process, contact NETLinfo@orau.org.

After you have submitted an application in Zintellect, you may reach out to internship.program@netl.doe.gov to request to talk with the hosting researcher if you would like additional information on the project or to express particular interest. You must have a completed application in Zintellect to receive a response.

Selection Decisions

Selection decisions are made directly by NETL researchers and staff looking to host an internship. Your application will be available to the hosting mentor(s) for up to 12 months after you apply. You may withdraw your application at any time. Applications may be reviewed and selected on a rolling basis or the hosting mentor(s) may choose to wait until after the application deadline before reviewing all applications simultaneously. A final decision of non-selection may not be confirmed for several months after the listed application deadline.

Application Deadline 6/30/2025 11:59:00 PM Eastern Time Zone

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Description The National Energy Technology Laboratory's (NETL's) record of success has been built on understanding the future of energy and the technologies required to make that future possible. We've long touted our success in developing the technologies that took on acid rain in the 1970s and mercury in the early 2000s.

Program Goals

The NETL Faculty Research Program (FRP) offers qualified academic faculty an opportunity to collaborate with NETL principal investigators on research that is mutually beneficial to NETL and the selected applicant at state-of-the-art NETL facilities. While typical appointments are part-time, some appointments are offered on a full-time basis during the summer or as a sabbatical. Prior to the appointment, the NETL principal investigator and selected applicant will define the scope of research and schedule the appointment period. Appointment periods range from one month to more than one year. Funding varies and is awarded based upon the participant's institutional salary. Faculty members are expected to elevate the collaboration with NETL by supporting connections with students at their home institution, in addition to the research project.

Connecting Students with NETL

The collaboration between the selected faculty member and NETL will include connecting their academic institution and students with NETL. Student connections may be fostered through activities such as, but not limited to, the following:

- Inviting NETL scientists and engineers to present at a departmental seminar
- Joining NETL at institutional career/job fairs to discuss your experiences with NETL
- Speaking about your experiences with NETL at information sessions
- Sharing invitations to NETL information sessions with students
- Partnering with NETL on proposals and other funding opportunities
- Recommending opportunities to NETL scientists and engineers, such as serving as a reviewer or editor, leading a workshop, etc.
- Serving as an ambassador to NETL for students interested in careers in the national lab complex

Research Project

Through the Oak Ridge Institute for Science and Education (ORISE), this posting seeks a faculty collaborator to engage in projects with the Research Innovation Center (RIC) at the National Energy Technology Laboratory (NETL) in the area of Methane Mitigation Technologies under the mentorship of Daniel Haynes. This project will be hosted by the NETL Morgantown, WV campus.

Microwave-based conversion systems offer faster rates in compact volumes, and enable electrification of the production of chemicals in modular, transportable processes. However the absorption of microwaves is inherently non-uniform, and reaction systems needs to be designed

and optimized to improve bed heating and temperature profiles to improve conversion efficiencies. The project supports the development of a novel microwave reactor system for the efficient conversion of methane to value-added products. The project will leverage AI-driven multi-physics modeling to optimize and screen reactor concepts to ensure high conversion efficiency, reduce energy consumption, and improve scalability.

The objectives include: (1) gaining insight into principles and mechanisms underlying microwave heating and its application to chemical reaction for methane conversion; (2) developing skills in multi-physics modeling tools that couple electromagnetic fields, fluid dynamics, and reaction kinetics; and (3) learning how to simulate and analyze the behavior of complex systems under different operating parameters and understanding how to use different AI techniques (machine learning, optimization algorithms) for improving reactor design and operational efficiency.

Stipend: The selected faculty participant will receive a monthly stipend commensurate with their institutional salary.

Deliverables: To document the effectiveness of the program, participants are required to submit a pre-appointment and post-appointment survey, as well as a reflection on their appointment experience when they renew or end their appointment. The reflection should summarize their project(s), additional activities, and overall experience. Details are provided as the appointment end date approaches.
Participants may also have the opportunity to contribute to manuscripts, journal articles, book chapters, conference presentations, posters, patents, and other publications as a part of their appointment. Such achievements should also be reported to ORISE; additional details are provided after an offer has been accepted.

The National Energy Technology Laboratory (NETL), part of the U.S. Department of Energy (DOE) national laboratory system, is owned and operated by the DOE. NETL supports the DOE mission to advance the energy security of the United States. This is an educational opportunity offered by NETL and administered by the Oak Ridge Institute for Science and Education. Participants in the program are not considered employees of NETL, DOE, the program administrator, or any other office or agency.

Qualifications To be eligible, applicants must be a full-time regular permanent faculty member at an accredited college/university with a research interest in NETL core R&D areas.

The ideal candidate would have:

- Chemical Engineer background with expertise in heterogeneous catalysis, reaction kinetic modeling, CFD multi-physics modeling, thermodynamics, and process engineering.
- Familiarity with microwave heating principles, including dielectric heating, and electromagnetic wave interactions with materials.
- Expertise in Artificial Intelligence techniques like machine learning and expertise in data analysis tools and programming languages.

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Point of Contact Ryan

Eligibility Requirements

- **Degree:** Master's Degree or Doctoral Degree.
- **Discipline(s):**
  - **Chemistry and Materials Sciences** (12 👁)
  - **Communications and Graphics Design** (2 👁)
  - **Computer, Information, and Data Sciences** (17 👁)
  - **Earth and Geosciences** (21 👁)
  - **Engineering** (27 👁)
  - **Environmental and Marine Sciences** (14 👁)
  - **Life Health and Medical Sciences** (51 👁)
  - **Mathematics and Statistics** (11 👁)
  - **Physics** (16 👁)
  - **Science & Engineering-related** (2 👁)
  - **Social and Behavioral Sciences** (29 👁)
- **Age:** Must be 18 years of age

Affirmation I certify that:

1. To the best of my knowledge all information contained in this application is accurate.
2. I am currently a faculty member at an accredited college/university.
3. I understand that any falsification will render me ineligible for participation and, if found after participation has begun, may require me to reimburse any funds received.