frontiers | Frontiers in Energy Research

TYPE Editorial
PUBLISHED 14 April 2023
DOI 10.3389/fenrg.2023.1193432

OPEN ACCESS

EDITED AND REVIEWED BY
Shripad T. Revankar,
Purdue University, United States

*CORRESPONDENCE
Richard Howard,
howardrh@ornl.gov

RECEIVED 24 March 2023
ACCEPTED 03 April 2023
PUBLISHED 14 April 2023

CITATION
Howard R (2023), Editorial: Advancements in nuclear and irradiation experiments.
Front. Energy Res. 11:1193432.
doi: 10.3389/fenrg.2023.1193432

Editorial: Advancements in nuclear and irradiation experiments

Richard Howard*

Oak Ridge National Laboratory, Oak Ridge, TN, United States

KEYWORDS

irradiation experiment design, advanced reactor, nuclear material, nuclear fuel, qualification acceleration

Editorial on the Research Topic
Advancements in nuclear and irradiation experiments

One fundamental aspect of nuclear energy research is the investigation of novel reactor technologies and qualification methods. The most promising concepts—such as accident-tolerant fuels, molten metal or salt coolants, and modular reactor systems—have been proven feasible through exhaustive analytical studies. However, qualification requires more rigor and risk reduction to convince regulators and licensures. Rigor and risk reduction can be achieved via nuclear and irradiation experiments, which are necessary for exploring material and system performance under the unique and harsh environments found in nuclear reactors. Such experiments are designed to investigate combined and separate effects phenomena, such as irradiation damage accumulation and fuel burnup, to establish operating performance limits, as well as inform component and fuel designs to improve operation efficiencies and mitigate proliferation vulnerabilities.

This special edition of *Frontiers in Energy Research* is titled *Advancements in Nuclear and Irradiation Experiments*. This area of research and innovation is generally considered complex and obscure given the wide range of irradiation facilities, qualification standards, and specialized experiences that are required to successfully execute these experiments. For example, researchers investigating a new fuel form will establish testing conditions (e.g., particle power, enrichment, operating temperature), but these requirements do not always directly apply to design characteristics that demonstrate safe installation and operation in a research reactor. Establishing conditions (e.g., exposing a specimen to a constant energy spectrum of particles) may force researchers to concede regarding what user facility is chosen for an experiment or lead to additional studies, such as showing equivalence between neutron and ion irradiation effects. Also, accounting for physical phenomenon such as instrumentation error, performance variability, and machining tolerances is critical for establishing reliable datasets that can be used to expand the technical state of the art. A useful experiment is designed to control critical variables so that the performance metrics of interest are observed with minimal bias and recorded for future study, hopefully resulting in innovation.

The making of a useful experiment is anchored is excellent communication and scientific collaboration. A holistic team is needed to facilitate such work so that essential characteristics and limitations are identified up front and all additional assumptions are evaluated to minimize undesirable outcomes. Currently, research depends heavily on modeling and simulation, which has undoubtedly led to accelerated technological advancement and

developments. Scientists and engineers seek new or better data to support their efforts, and their input is required to target such knowledge gaps. However, models are more conveniently interrogated than experiments, and modelers must work with experimentalists to understand what can be physically measured. Conversations must be held to resolve research goals so that our understanding of physical phenomena is increased at the experiment's conclusion. This understanding is particularly important for studies that involve irradiations because these studies require an additional or nested irradiation experiment to investigate effects on the material or system. Therefore, the editors implore readers to maintain their questioning attitudes and work closely with their collaborators. Good science comes from good dialogue, documentation, and cooperation. This work is an excellent example of collaborations between experimentalists and analysts, irradiation experiment designers and fuels researchers, and programmatic stakeholders and research reactor operators to ensure meaningful scientific outcomes are achieved.

This installment of *Frontiers in Energy Research* contains several high-quality articles that focus on various aspects and points discussed in this editorial. These articles discuss subjects such as fundamental performance of materials, the establishment of irradiation tests beds for nuclear security applications, and experiments that propose of use analytical techniques (e.g., laser-induced breakdown spectroscopy) to characterize molten proposed salt off-gas sensors. This work will support control and safety systems needed to deploy advanced reactor technologies that will replace the current and aging light-water power reactor systems used by most of the world. Likewise, these articles present metal alloy fuels research that focuses on experiment design, modeling, and post-irradiation experimentation and characterization.

My editorial colleagues and I hope that the scientific community finds this edition of *Frontiers in Energy Research* enriching. Nuclear and irradiation experiments are critical to advancing nuclear energy technologies, and the articles within this special edition demonstrate this utility firsthand. The articles exhibit successful examples of a broad scientific community that comprises analysts, programmatic leaders, experimentalists, and applied and fundamental researchers working together to meet common goals. We hope readers are inspired not only by the work presented here but also by the collaborations demonstrated by these authors' work. In closing, I request that we all strive to build strong working relationships with our colleagues and learn from each other. Go forward and do good work.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note