U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

Clean. Reliable. Nuclear.

Develop and Maintain Capabilities to Support Instrumentation and Control Technology Deployment

Advanced Sensors and Instrumentation Annual Webinar

November 5 , 2020

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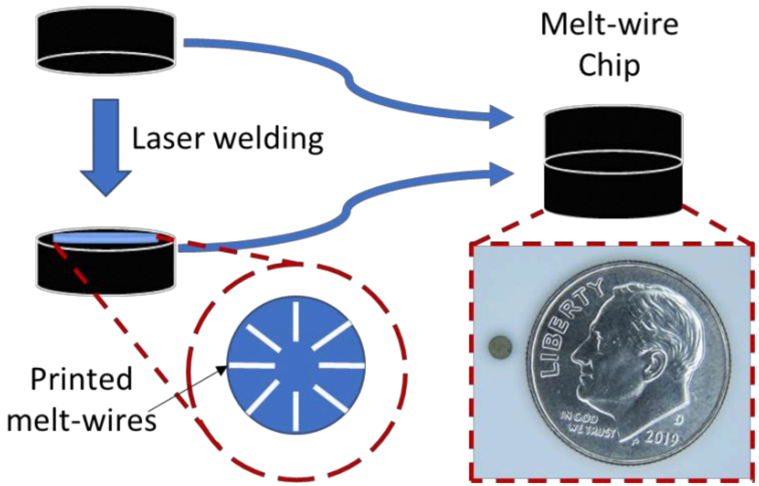
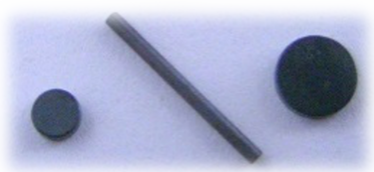
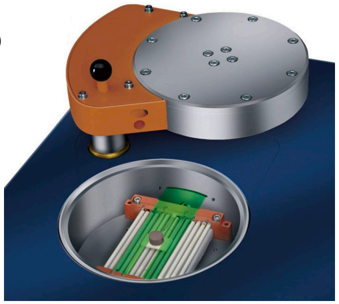
Project Overview

1. Passive Monitors:
   - Printed Melt Wires
   - SiC Monitors




SiC Passive Monitors


Optical Dilatometer

2. LVDTs

1. Passive Monitors

Goal and Objective

Provide a practical and reliable approach to estimate peak irradiation temperature during PIE for direct integration in irradiation test designs.

Participants (2020)

- Idaho National Laboratory
    1. SiC Monitors: Malwina Wilding, Kurt Davis, Ashley Lambson, and Kory Manning
    2. Printed Melt Wires: Kiyo Fujimoto, Kunal Mondal, and Michael McMurtrey

Schedule

- December, 2019: Complete optical dilatometer installation and analysis procedure
- March, 2020: Initial Temperature Testing of Advanced Manufactured Melt Wire Package

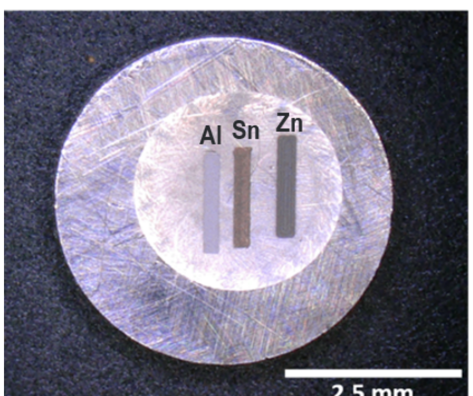
Accomplishments

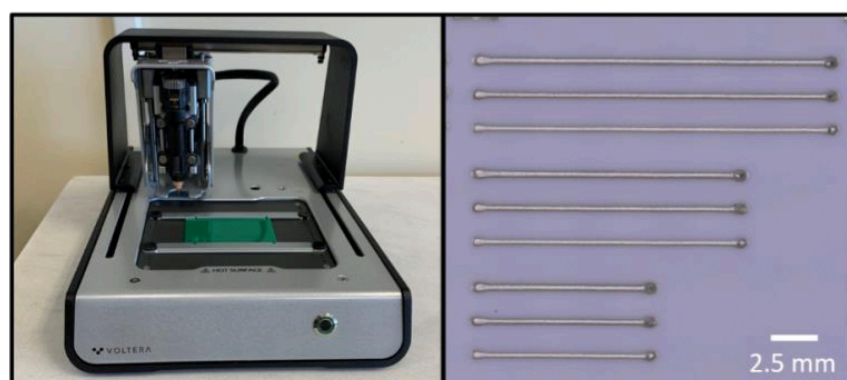
1. SiC Monitors:

- Completed optical dilatometry installation in the radiation area in the laboratory
- Established a measuring and evaluation methods for measuring estimated irradiation peak temperatures using the BR2 irradiated samples

2. Printed Melt Wires:

- Finish initial temperature testing for advanced manufactured melt wire package
- Prepared four melt wire chips for Westinghouse for MITR experiment





Technology Impact

- *Advances the state of the art for nuclear application*

Passive monitors for temperature are needed for when real-time sensors are not practical or economical to install in an irradiation test. Additionally, utilizing advanced manufacturing facilitates the production of novel sensor designs for in-pile sensors and instrumentation designs that are not otherwise achievable through classical fabrication techniques.

- *Supports the DOE-NE research mission*

Facilitates the development of advanced sensors and instrumentation with cross-cutting technology development to support the existing fleet, advanced reactor technology and advancing fuel cycle technology development.

- *Impacts the nuclear industry*

Development of advanced methods and capabilities to enable transformative sensor technology for in-pile monitoring and in-situ analysis of fuels and materials.

2. LVDTs

Goal and Objective:

Develop and test displacement and pressure instruments based on Halden LVDT technology to ensure continuity of measurement capability and explore commercialized LVDT applications for in-pile instrumentation.

Participants (2020)

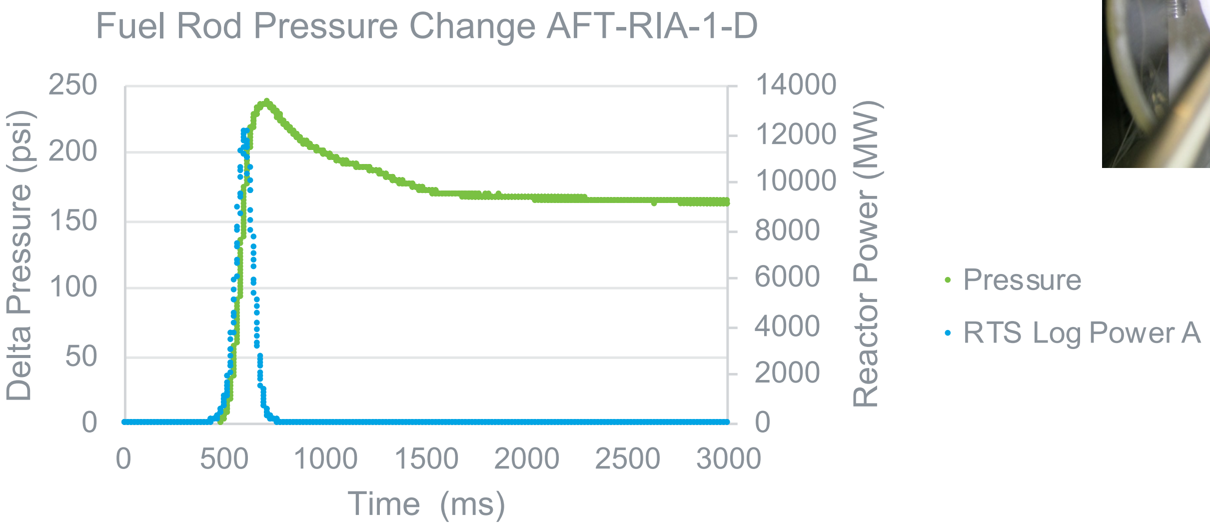
- Idaho National Laboratory: Kurt Davis, Malwina Wilding, Austin Fleming
- Boise State University: Brian Jaques, Zhangxian (Dan) Deng
- University of Pittsburg: Heng Ban

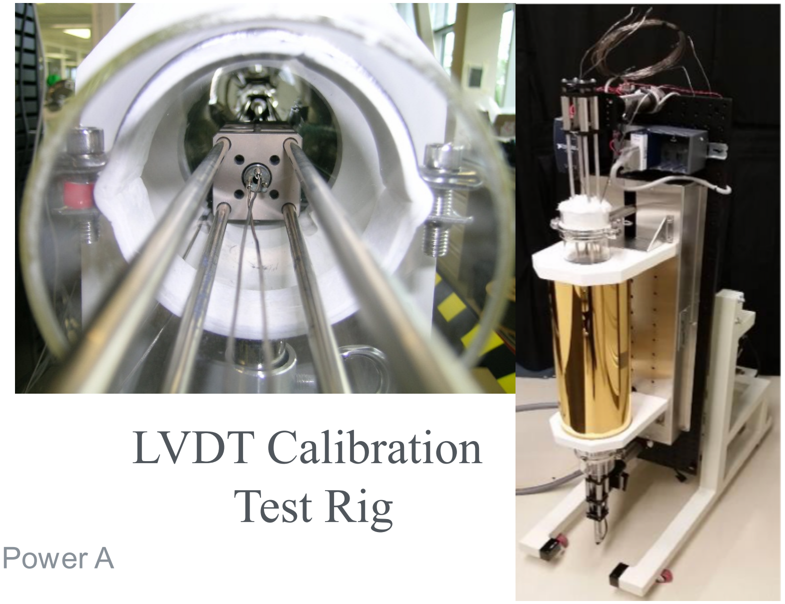
Schedule

- December, 2019: Established calibration technique for LVDTs configured to measure displacement
- February, 2020: Established calibration technique for LVDTs configured to measure pressure

Accomplishments

- Established calibration technique for LVDTs configured to measure pressure or displacement.
- This calibration technique has already been adopted and used by the ATF-program for several irradiation experiments successfully deployed in TREAT





LVDT Calibration Test Rig

Technology Impact

- *Advances the state of the art for nuclear application*

  With the closure of the Halden Reactor, this work maintains LVDT measurement capabilities that would otherwise be lost. Exploring the use of commercial LVDTs for in-pile use is a potential avenue for ensuring sensors remain available for use in material test reactors.

- *Supports the DOE-NE research mission*

  LVDT sensors have been used in the M-SERTTA test rig at TREAT and are currently being designed into future test rigs that support testing of fuels in PWR and liquid metal environments. LVDTs are also being designed into future Navy tests that will be conducted at ATR.

- *Impacts the nuclear industry*

  LVDTs are a critical asset in the design of new fuel, cladding, and structures in next generation and existing nuclear reactors. Such materials can experience significant changes during high temperature irradiation, and real-time monitoring of dimensional or pressure changes is paramount to understanding the performance of these new materials.

Conclusion

- SiC Passive Monitors: completed optical dilatometry installation, testing and analysis procedure for upcoming irradiated samples from various INL experiments
- Printed Melt Wires: completed initial temperature testing of advanced manufactured melt wire package and fabricated four melt wire chips for Westinghouse for MITR experiment
- LVDTs: Established calibration technique for LVDTs configured to measure pressure or displacement that were successfully deployed in TREAT
- *Questions?*
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