Serial Crack Propagation Strain and Temperature Sensors

Program Kickoff

7057-DOE-1S - 36i Phase I

Award No. DE-SC0022824

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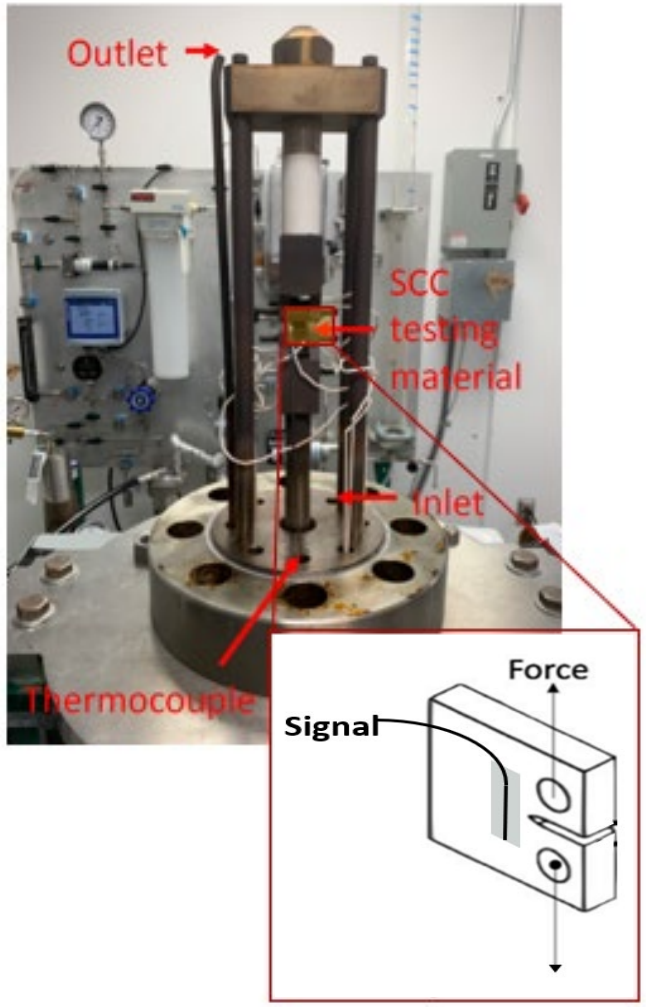
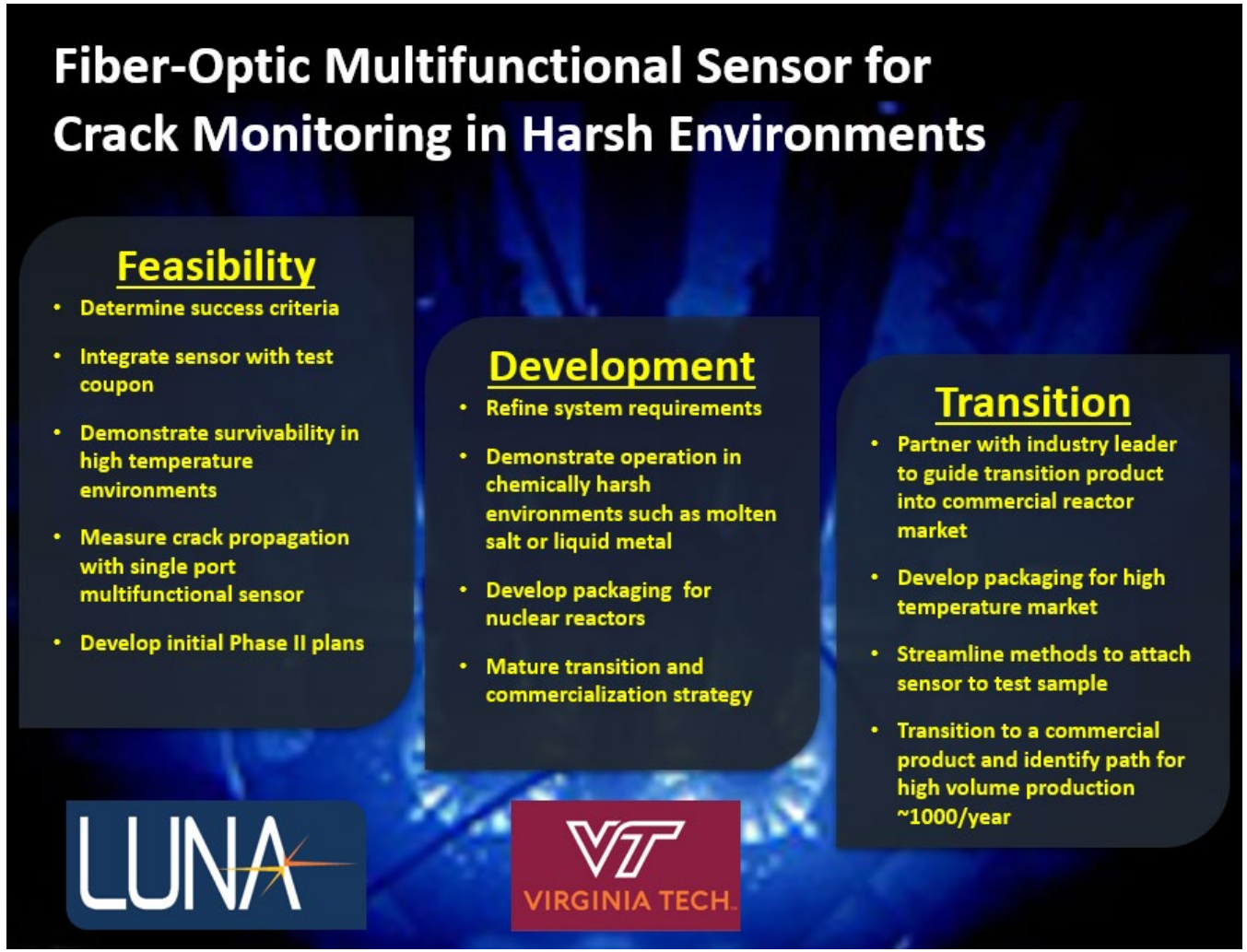


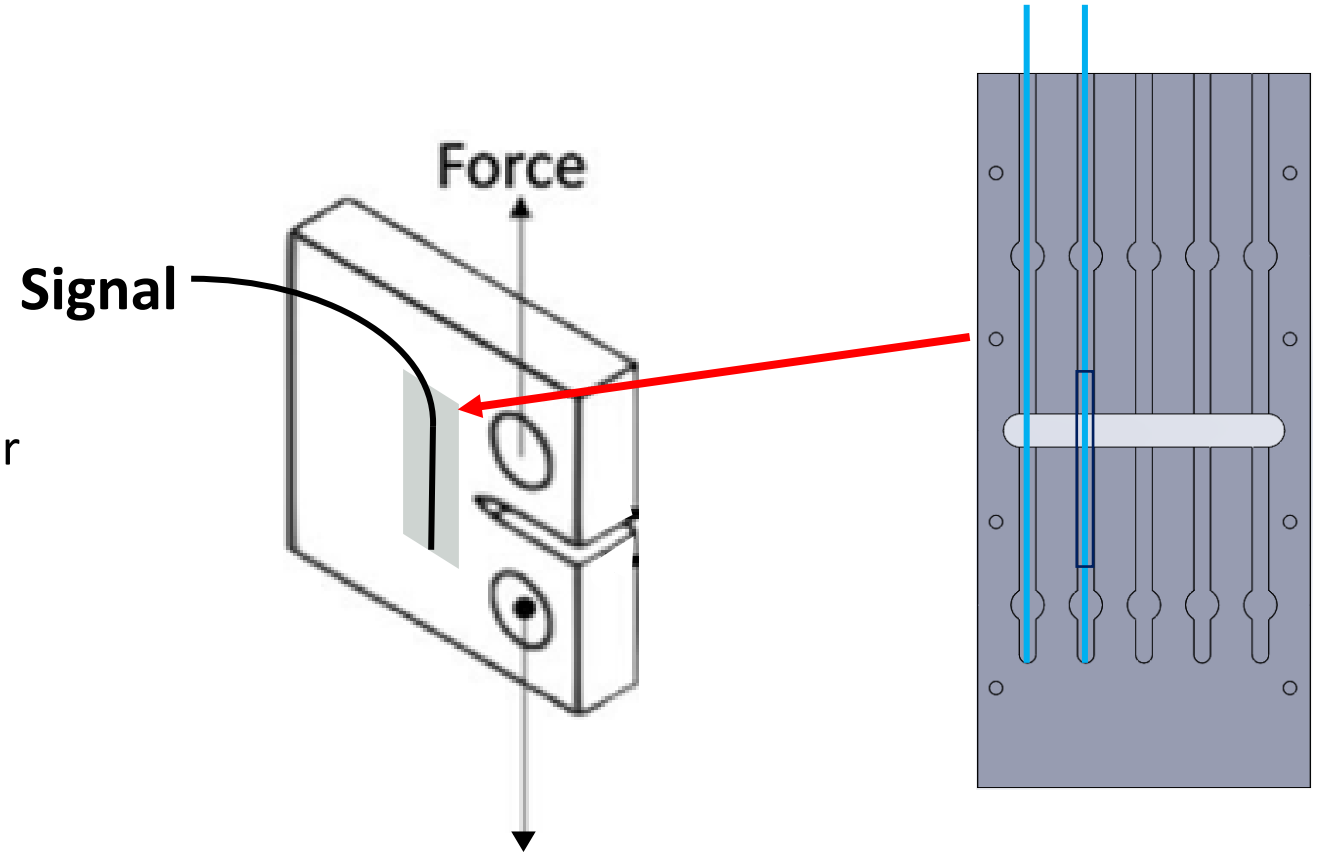
Motivation

- Development of multi-parameter optical sensors for harsh environment SCC testing and monitoring
  - Temperature
  - Strain
  - Other measurands of interest?
- Sensors utilize Fiber Bragg Gratings (FBGs) and Fabry-Perot (FP) Interferometers (FPI)
- Coarse wavelength division multiplexing allows for serial deployment of FPI
- Luna's Hyperion platform allows interrogation of sensors up to 5kHz.
  - Full waveform at ~800Hz



Design Multi-Parameter Crack Monitoring Sensor for Sample Integration in VT's Stress Corrosion Cracking (SCC) Tester

- Evaluate crack propagation in pe-notched 316 stainless steel test coupons
- Displacement gauge was housed on a spot weldable sensor mount
- Sensor application will need to be developed for nonmetallic samples
- Configuration will provide displacement due to notch opening and temperature near the gauge

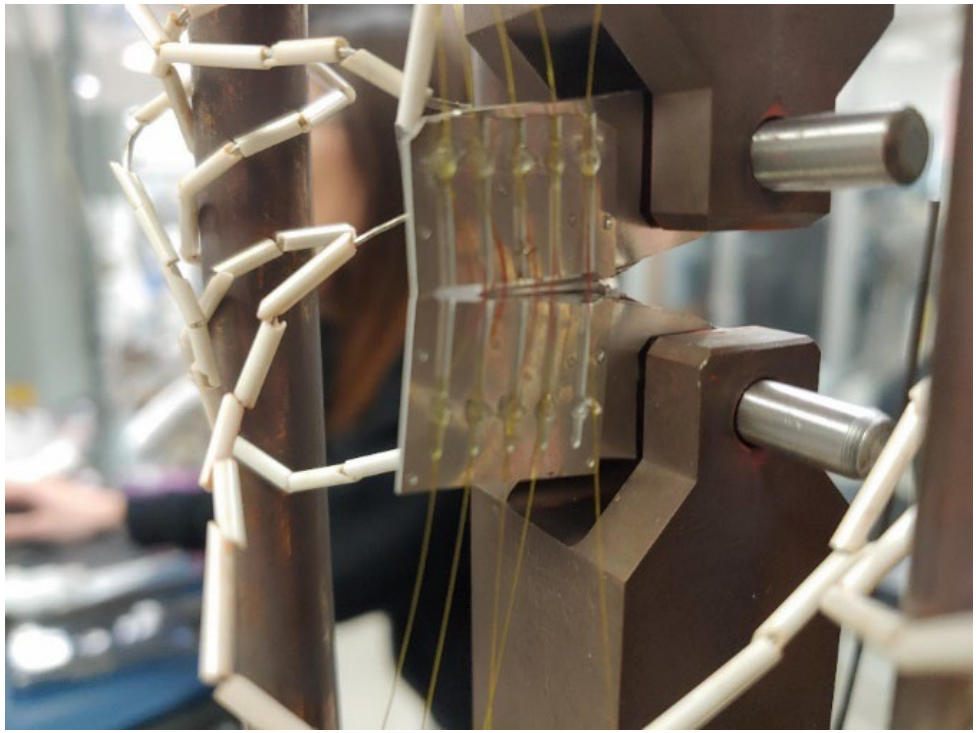


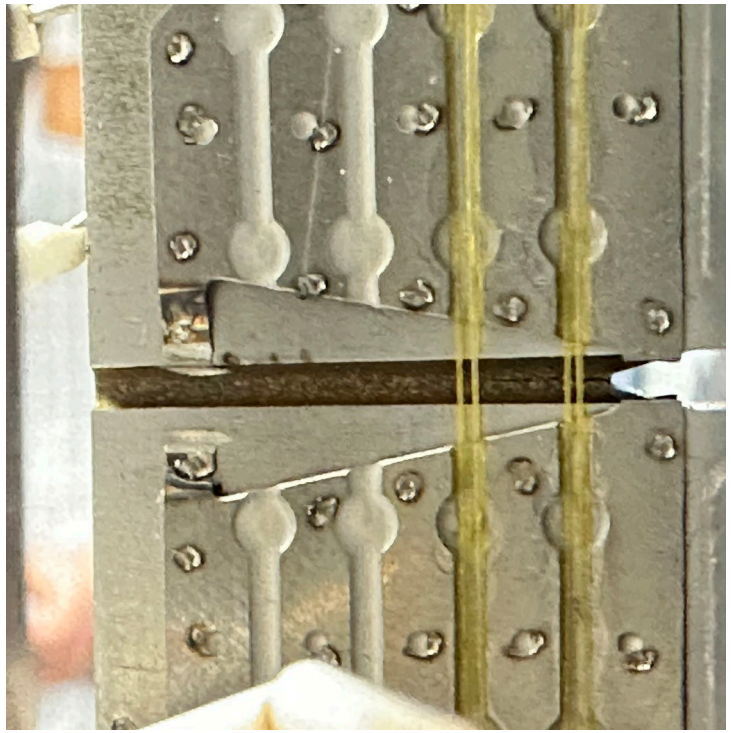
Characterize Prototype Sensor Capability for Crack Propagation

- Phase I SCC sampling was conducted at the following conditions:
  - Sample at room temperature
  - Sample at high temperature (up to 320°C) in inert gas
  - Sample submerged in liquid metal (Pb)
- Phase II SCC testing will be conducted to assess survivability in molten salt

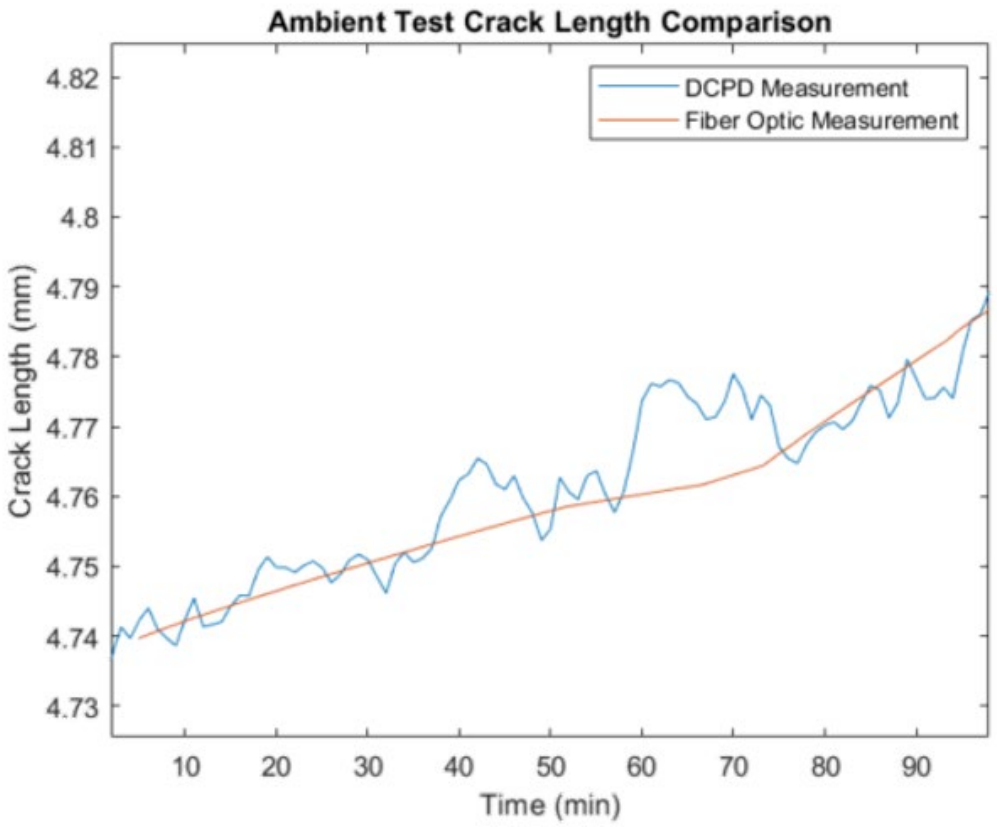
Fatigue Load Testing Setup

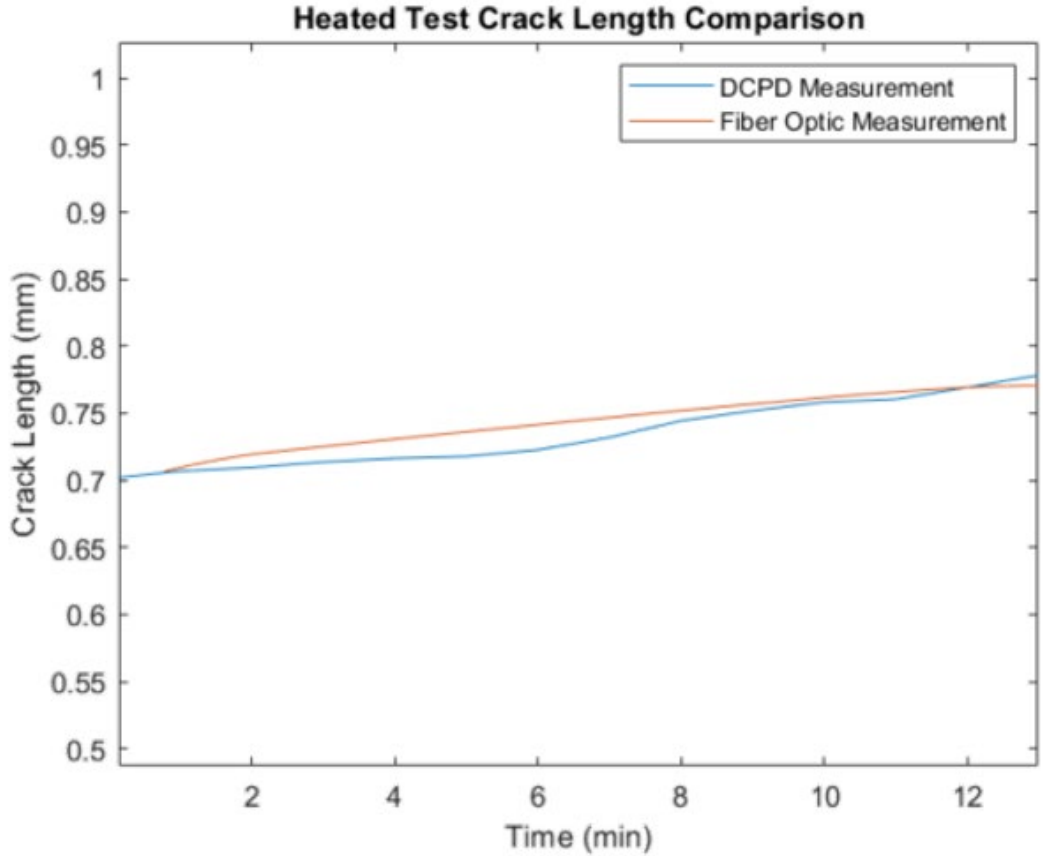
- Fatigue testing on an ASTM E647 standard specimen of stainless steel
- Load frequency varied between 1-2 Hz
- Stress intensity factor was constant at 20 MPa√m





ASTM E647 Test Data Results





Molten Lead Bismuth Eutectic Testing

- LBE testing was conducted to assess the survivability of the fiber optic sensors in high temperature, liquid lead environments
- Evaluation was done on both FBG sensors and HD-FOS
- Temperatures ranged from 260°C for long durations and 400°C for short intervals
- Testing was done for a continuous 190 hours