



Development of Additively Manufactured Strain Gauges

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Changing the World's Energy Future

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Development of Additively Manufactured Strain Gauges

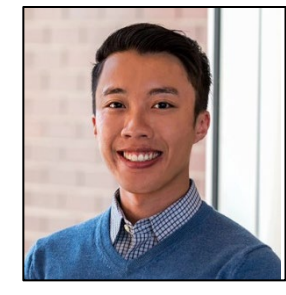
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PRESENTER

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Background

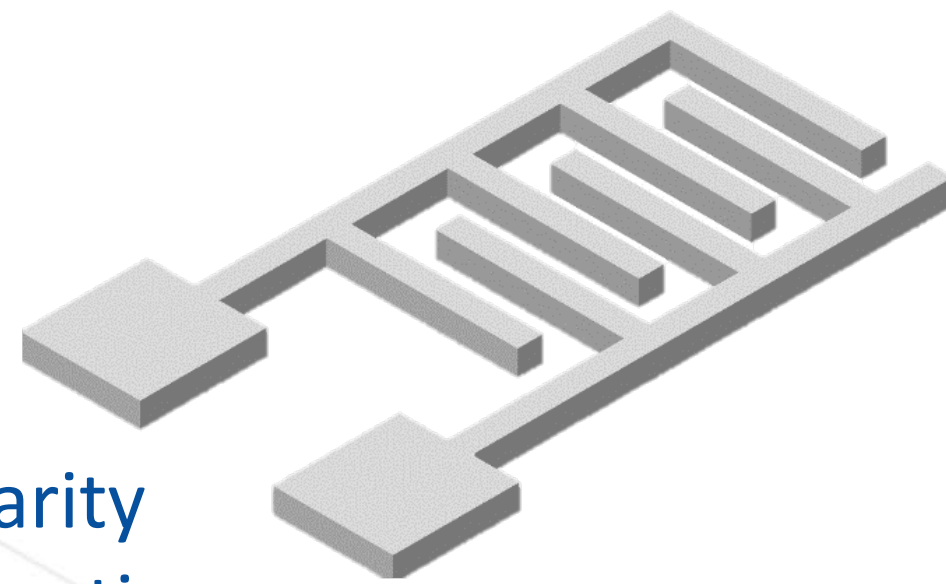
Monitoring real-time strain is an enabling capability that provides key mechanical properties of nuclear materials during experiments at irradiation test facilities. In this work, direct-write additively manufacturing is used to fabricate strain gauges that, with further development, addresses the critical technology gaps for nuclear-relevant and compatible strain sensing methods.

Methods

Design

Interdigitated Electrode

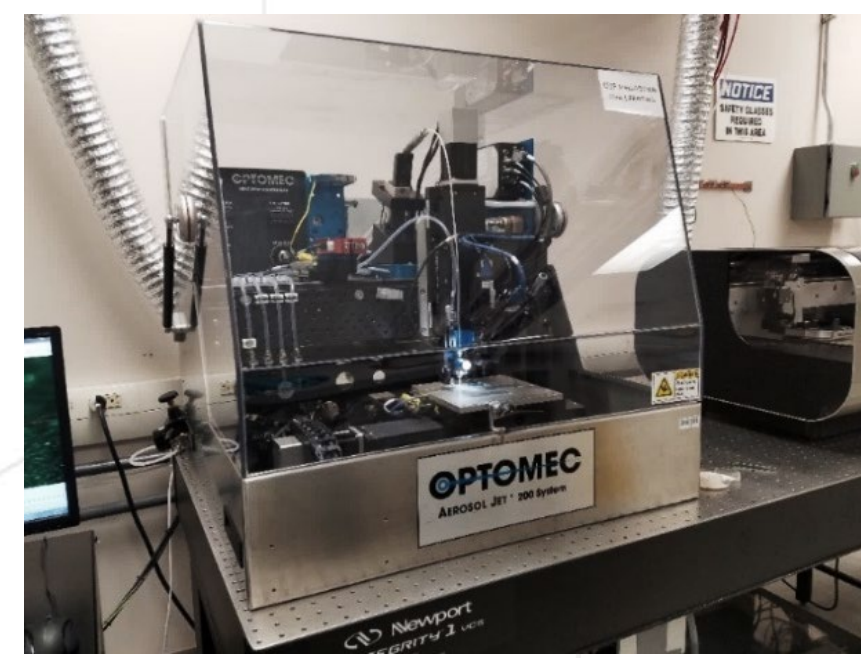
- Capacitance-based
- Low-profile; high linearity
- Enables wireless integration



Fabrication

Aerosol Jet Printing

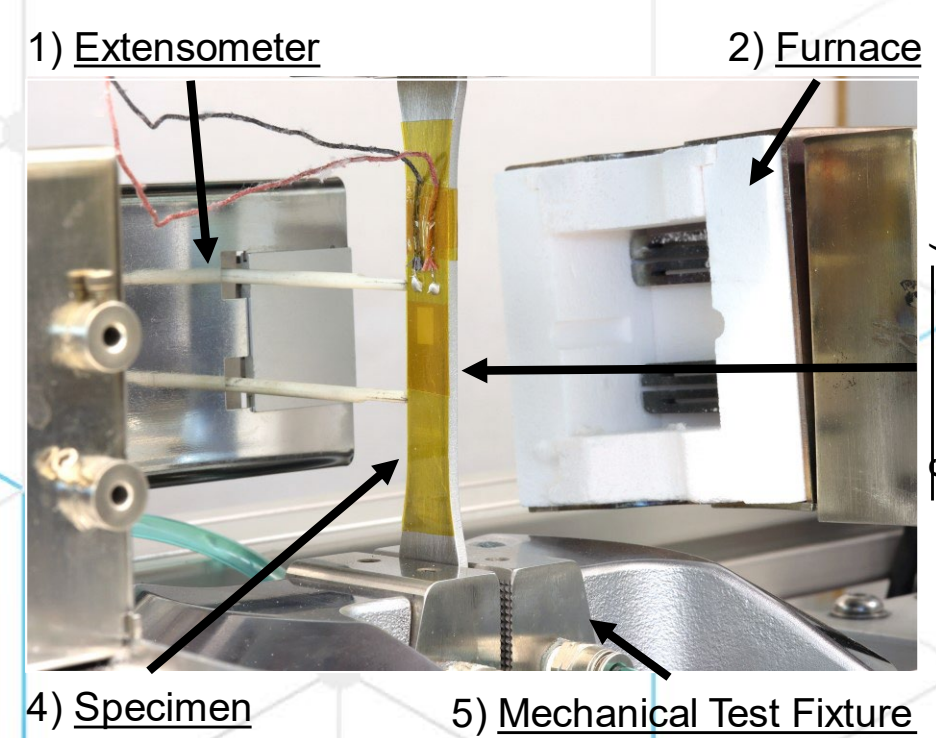
- Direct fabrication
- Reduced invasiveness
- Compatible with wide range of material



Testing

Mechanical Test

- 300°C environment
- Mechanically loaded in tension
- Compared to commercial sensor

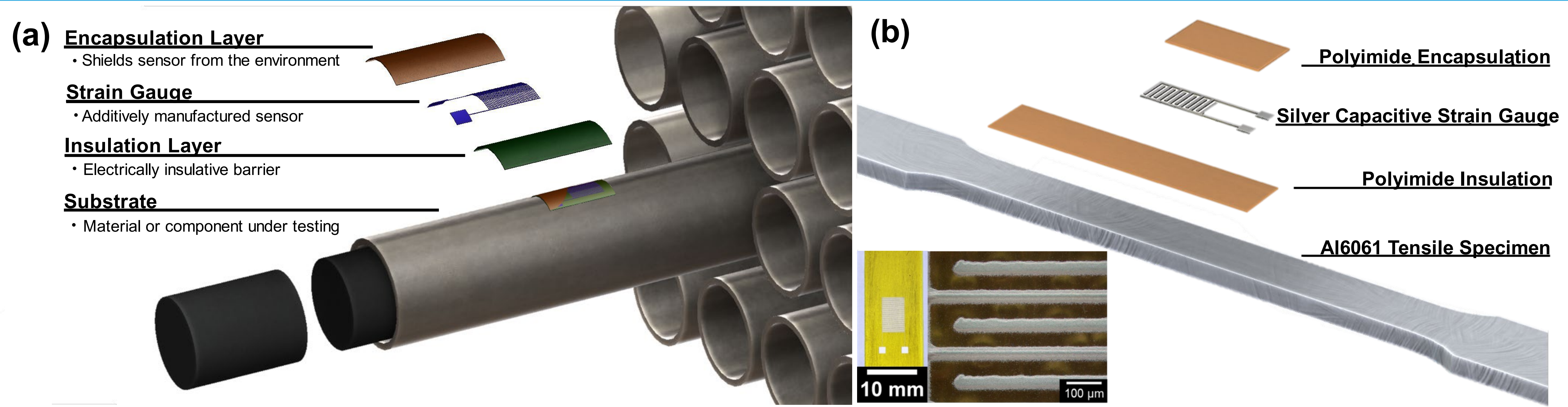


Technological Impact

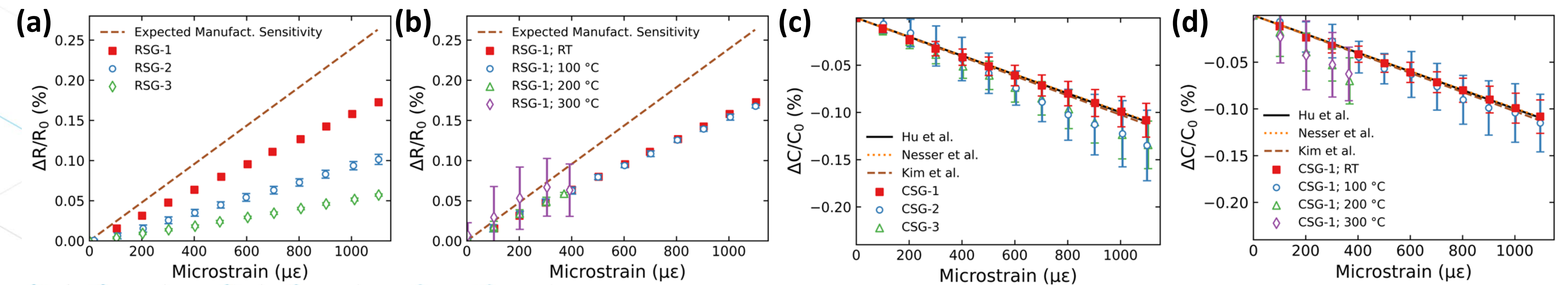
Additive manufacturing expand the capabilities of strain gauges by allowing for its application in areas where there are specialized design needs and requirements (e.g., materials restriction, miniaturized specimen, etc.).

Development of Additively Manufactured Strain Gauges

- Measured mechanical strain of structural materials
- Survived prototypic LWR temperatures (300°C)
- Printed sensor had predictable & repeatable performance



Above: Schematic of interdigitated capacitive strain gauge on a (a) fuel pin and (b) aluminum alloy 6061 tensile specimen presently studied



Above: Results for a commercial resistive strain gauge (RSG) and printed capacitive strain gauge (CSG) at room [(a),(c)] and high temperatures [(b),(d)]



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