Title: Development of Additively Manufactured Strain Gauges

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Abstract: Monitoring strain within the confined and hostile conditions of nuclear reactors are of interest for the measurement of deformation and vibrations of fuel elements and structural components during reactor power cycles. Resistive strain gauges represent a well-established technology traditionally used to measure localized strain and deformation at strategic locations on a component. Resistive strain gauges, however, have limited applications during in-pile experiments due to the harsh operating conditions and confined physical space between fuel and cladding components. In this work, additive manufacturing techniques were used to fabricate interdigitated electrode capacitive strain gauges directly on aluminum alloy 6061 tensile specimens. To simulate the temperatures of a traditional light water reactor, the performance of the capacitive strain gauges was tested with a mechanical test frame up to 300 °C and compared to commercially available bondable resistive strain gauges. The results demonstrate the potential of using additive manufacturing techniques to fabricate strain sensors with predictable performance and reduced invasiveness for high-temperature applications.