# 3-D Strain Mapping in Composite Pressure Vessels

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This investigation reports on the use of additively manufactured biaxial strain gauge sensors for assessing the loads and deformations in a linerless (type V) composite pressure vessel (CPV). Fused deposition modeling (FDM) is a widely used rapid prototyping/additive manufacturing technique due to its relatively fast processing time and low cost. However, additive manufacturing of strain gauge sensors using FDM is uncommon because there are very few suitable conductive filaments commercially available. The filament selected for the strain gauge sensors in this study is a conductive polymer with low resistivity and high melting point which are crucial for the strain gauge to maintain its shape and integrity to obtain accurate, low power readings after being subjected to high temperatures during the post-curing process of CPVs. A small footprint and the lack of a permanently attached substrate allows the placement of strain gauges integrated into the composite layer to have minimal impact on the structural integrity of the pressure vessel. The applications for this study include but are not limited to pressurant and propellant tanks for launchers and spacecraft, self-contained breathing apparatus, space habitats and alternative fuel tanks.

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