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# C2Po1F-07: Thermal conductivity measurements for additively manufactured AlSi10Mg and Al6061-RAM2 aluminum composites at cryogenic temperatures

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Advances in 3D printing are disruptive opportunities for material selection and component design in cryogenics. However, thermophysical property measurements for these novel materials are generally unavailable at cryogenic temperatures. This experiment explores the variation in thermal conductivities due to print direction of two aluminium composites (AlSi10Mg and Al6061-RAM). The direct linear heat flow method was utilized to calculate thermal conductivities using a measured wattage input, temperature differential, and Fourier's Law of Conduction. A multi-measurement linear regression was applied to determine thermal conductivities at fixed average temperatures over the range from 20-100K. The AlSi10Mg composite had a greater thermal conductivity than Al6061-T6 for both printing planes by approximately 230%. The XY-plane print direction resulted in a reduction in thermal conductivity than the Z-plane by approximately 30%. The AL6061-RAM composite had effective thermal conductivities smaller than the machined Al6061-T6 by approximately 70%. The thermal conductivity in the Z-plane print direction was consistently greater than the thermal conductivity in the XY print direction. Validation studies were conducted utilizing Al6061-T6 and SS-304/304L. The calculated deviation for the validation samples depicted a 20% difference from the recommended reference values from the National Institute of Standards and Technologies (NIST). The calculated uncertainty of the experimental system was 5-10%; increasing with decreasing temperature. These preliminary measurements depict the need for further analysis on 3D printed composite materials and reverification of common materials, due to current manufacturing methods improving since the experimental measurements for SS-304/304L and Al6061-T6.

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