Liquid Metal Transient Hot Wire Method to Determine the Thermal Conductivity of Stereolithographic 3D Printed PEGDA

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As the field of microfluidics expands, there are gaps in the material property data available. Recent advances in 3D printing have opened the way for new polymers to be used during microfluidic creation. Polyethylene glycol diacrylate (PEGDA) is a material that is being explored for microfluidic devices with void resolutions of 7.6 μm x 10 μm. These PEGDA-based devices are being developed to create precise 3D temperature distributions, but designing such devices via numerical modeling of heat transfer is impeded by the lack of thermal property information available. We investigated the thermal properties ourselves by applying the transient hot wire (THW) method to a microfluidic device designed to have a 40 μm x 38 μm channel filled with Galinstan liquid metal as the wire material surrounded by solid PEGDA. To accomplish this, we also had to investigate the temperature coefficients of resistivity (TCR) of Galinstan, because of disparity in the literature. We measured the thermal conductivity of the printed PEGDA device (0.275±0.02 W/m*K) and validated it by taking measurements with a commercial device for the Transient Plane Source (TPS) and a Laser Flash Analysis (LFA) measurement. With this, we have found the thermal properties that were missing for PEGDA and validated the THW method with a liquid metal as the wires for measuring the thermal conductivity of polymers.