Adapting the Transient Hot-Wire Method to Find the Thermal Conductivity of Stereolithographic 3D Printed Resins

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With the increased interest in microfluidic devices in the biomedical field, rapid device construction using stereolithographic (SLA) 3D printing can open new opportunities. However, the thermal properties of the printed material that are needed to accurately predict the temperature distribution inside the device are often unknown. We propose using the transient hot-wire method (THM) with a liquid metal as the hot-wire material to measure the thermal conductivity of printed material used to create microfluidic devices. There are limited studies that have used a liquid metal as the hot-wire material and there is very limited thermal property information of resins useful for SLA 3D printing, specifically solidified polyethylene glycol diacrylate (PEGDA), 1,6-hexanediol diacrylate (HDDA), and trimethylolpropane ethoxylate (TET). We have designed devices taking advantage of the resolution of SLA 3D printing, printed and filled the devices with liquid metal, performed the resistance-temperature calibration, and have used the THM to find the thermal conductivity. Device design validation was done through modeling the THM device with nylon using COMSOL and verifying the calculated thermal conductivity with that found in literature. Our findings demonstrate a novel method to measure the thermal conductivity quickly for resins that are useful for SLA and can improve thermal models using these materials.