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PROCEEDINGS

Radio Frequency-Assisted Curing of On-Chip Printed Carbon Nanotube/silicone Heatsinks Produced by Material Extrusion 3D Printing

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ABSTRACT

With the rapid development of high-power integrated electronic devices, many polymer-based thermal management devices have been developed to address the problem of overheating and to improve the reliability and lifetime of electronic devices. Here we demonstrate the material extrusion 3D printing of carbon nanotube (CNT)/silicone heatsinks directly onto electronic devices. CNTs were used as a conductive nanofiller and a rheological modifier to improve thermal and electrical conductivities and the printability of the silicone inks, respectively. Additionally, CNTs are also a radio frequency (RF) susceptor, so the integration of CNTs into the silicone matrix allowed for rapid out-of-oven curing by applying RF heating. Specifically, at a CNT loading of 14 wt.%, the CNT/silicone heatsinks could be printed and RF cured with shape retention; the heatsinks' performance was comparable to that of commercial heatsinks. More importantly, the CNT/silicone heatsinks could be printed and cured directly onto a chip attached to a circuit board. This printing approach can eliminate the use of thermal interface materials and the step of heatsink assembly while reducing the number of thermal interfaces between the chip and the heatsink. The results suggest that material extrusion 3D printing combined with RF-assisted curing can be an effective approach to fabricate high-performance polymer-based heatsinks with reduced production time and energy requirements.

KEYWORDS

Material extrusion; carbon nanotube; radio frequency heating; silicone; heatsink

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