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Microwave Induced Welding of Carbon Nanotube-Thermoplastic Interfaces for Enhanced Mechanical Strength of 3D Printed Parts CHARLES SWEENEY, BLAKE LACKEY, Texas AM University Department of Chemical Engineering, MOHAMMAD SAED, Texas Tech University, MICAH GREEN, Texas AM University Department of Chemical Engineering — Three-dimensional (3D) printed parts produced by fused-filament fabrication of a thermoplastic polymer have become increasingly popular at both the commercial and consumer level. The mechanical integrity of these rapid-prototyped parts however, is severely limited by the interfillament bond strength between adjacent extruded layers. In this report we propose for the first time a method for welding thermoplastic interfaces of 3D printed parts using the extreme heating response of carbon nanotubes (CNTs) to microwave energy. To achieve this, we developed a coaxial printer filament with a pure polylactide (PLA) core and a CNT composite sheath. This produces parts with a thin electrically percolating network of CNTs at the interfaces between adjacent extruded layers. These interfaces are then welded together upon microwave irradiation at 2.45GHz. Our patent-pending method has been shown to increase the tensile toughness by 1000% and tensile strength by 35%. We investigated the dielectric properties of the PLA/CNT composites at microwave frequencies and performed in-situ microwave thermometry using a forward-looking infrared (FLIR) camera to characterize the heating response of the PLA/CNT composites upon microwave irradiation.

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