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Understanding and Improving the Quality of Inter-Layer Interfaces in FDM 3-D Printing EDWARD DURANTY, BRANDON SPRADLIN, MADELINE STARK, University of Tennessee, MARK DADMUN, University of Tennessee, Oak Ridge National Laboratory — We have studied the effect of thermal history and material diffusion on inter-filament bonding in FDM 3D printed parts and developed methods to improve interlayer adhesion in 3D printed samples. The available thermal energy during the FDM print environment was determined quantitatively by tracking the temperature of the bottom most printed layer using a thermocouple attached to the print bed. The role of the thermal history of the filaments during the deposition process on the quality of inter-layer bonding in an FDM ABS part was monitored using a T-peel test and an innovative sample design. Additionally, the interfacial adhesion between 3D printed layers was improved by the addition of a chemical cross-linking agent 4,4′-diaminodiphenylmethane (DADPM). These studies have increased our understanding of the importance of the complex thermal history of a filament in the 3D printing process and its impact on the interfaces that form during the fused deposition modeling print process. Furthermore, the chemical crosslinking process demonstrates a potential method to covalently link layers in FDM printed parts, improving the bulk strength of the part. The insight provided in this work may aid in the development of techniques that can produce FDM parts that could be used as replacement parts in structural applications, or as completely standalone products.

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