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A Molecular Perspective of Inter-filament Bonding in Fused Deposition Modeling 3-D Printing EDWARD DURANTY, BRANDON SPRADLIN, MARK DADMUN, University of Tennessee — Fused deposition 3D printing is an important tool for low-cost and rapid prototyping of objects with complex geometries. 3D printed materials are composed of many filaments deposited on a heated substrate, requiring the bonding of neighboring filaments during the deposition process. Filament deposition often creates voids between filaments, which requires necking between them to create a robust sample. Therefore the amount of interfacial contact and interdiffusion between filaments become important parameters that control the macroscopic physical properties of the printed prototype. Our research focuses on quantifying the interfacial adhesion between ABS filaments and its impact on structural properties. The time evolution of the temperature profile near the heated substrate demonstrates that the deposited filaments are repeatedly heated above the Tg of ABS allowing interpenetration of the polymer chains between adjacent filaments. Results of DMA experiments on samples of different geometries have been correlated to microphotography that monitors the degree of necking between filaments and the thermal history. Results indicate that interfacial contact area between filaments and increased thermal energy are crucial to their mechanical properties.

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