Abstract Submitted
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Coarse-Grained Simulations of 3D Printing[1] ZILU WANG, ANDREY DOBRYNIN, University of Akron — 3D printing is a revolutionary manufacturing technique which makes it possible to fabricate a 3D object of any shape and size that is hard to make by traditional methods. We use coarse-grained molecular dynamics simulations to model the Continuous Liquid Interface Production (CLIP) 3D printing techniques. This technique utilizes a continuous curing of the liquid precursor by the UV light within a thin layer during pulling the crosslinked polymeric object out of a liquid pool. Our simulations show that the quality of the shape of the 3D printed objects is determined by a fine interplay between elastic and capillary forces. With decreasing the size of the printed features, the object shape deformations are controlled by optimization of the surface area of the exposed interface. This results in large deviations of the printed shape from the programed one. The high quality of the printed features is obtained when its size is larger than the elastocapillary length – ratio of the surface tension and modulus of crosslinked polymeric material. The condition when size of the feature becomes comparable with the elastocapillary length could be considered as a resolution limit for this 3D printing technique. Using our simulation results we have identified the source of the object shape deformations and developped a set of rules for calibration of the parameters to meet the accuracy requirements. To improve printing quality we have redesigned the CLIP 3D technique. Our simulations show that the proposed modifications of the printing process could improve printing quality.

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