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Measuring the nanoscale properties of laser-deposited glassy polymer nanodroplets KIMBERLY SHEPARD, Department of Chemical and Biological Engineering, Princeton University, CRAIG ARNOLD, Department of Mechanical and Aerospace Engineering, Princeton University, RODNEY PRIESTLEY, Department of Chemical and Biological Engineering, Princeton University —
Glassy polymer nanodroplets are fabricated via the Matrix Assisted Pulsed Laser Evaporation (MAPLE) technique using short deposition times. At longer deposition times, the nanodroplets act as nanoscale building blocks, forming nanostructured bulk films with thickness on the order of microns. These nanostructured glassy films exhibit unique properties, including 40% reduced density along with a 40K increase in the glass transition temperature compared with glasses prepared by cooling from the liquid state. Indirect experimental study of the thermal properties of the nanoscale features has indicated that the stability of the bulk film may be a result of the nanostructure. Here, we directly measure the properties of the nanoscale building blocks and connect the results to observations about the global film properties. Heated atomic force microscopy is used to measure the volume of individual nanodroplets as they are heated in situ. MAPLE-deposited droplets exhibit large excess volumes and enhanced thermal stability compared with similarly-sized droplets prepared from polymer nanoparticles. We discuss this behavior in the context of the MAPLE process of nanodroplet formation.

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