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A compressible multiphase framework for simulating supersonic atomization JONATHAN D. REGELE, DANIEL P. GARRICK, ZAHRA HOSSEINZADEH-NIK, MOHAMAD ASLANI, Iowa State University, MARK OWKES, Montana State University — The study of atomization in supersonic combustors is critical in designing efficient and high performance scramjets. Numerical methods incorporating surface tension effects have largely focused on the incompressible regime as most atomization applications occur at low Mach numbers. Simulating surface tension effects in high speed compressible flow requires robust numerical methods that can handle discontinuities caused by both material interfaces and shocks. A shock capturing/diffused interface method is developed to simulate high-speed compressible gas-liquid flows with surface tension effects using the five-equation model. This includes developments that account for the interfacial pressure jump that occurs in the presence of surface tension. A simple and efficient method for computing local interface curvature is developed and an acoustic non-dimensional scaling for the surface tension force is proposed. The method successfully captures a variety of droplet breakup modes over a range of Weber numbers and demonstrates the impact of surface tension in countering droplet deformation in both subsonic and supersonic cross flows.

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