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Dynamics of Non-Newtonian Liquid Droplet Collision[1] XIAODONG CHEN, VIGOR YANG, Georgia Institute of Technology — Collision of Newtonian liquid droplets has been extensively investigated both experimentally and numerically for decades. Limited information, however, is available about non-Newtonian droplet collision dynamics. In the present work, high-fidelity numerical simulations were performed to study the situation associated with shear-thinning non-Newtonian liquids. The formulation is based on a complete set of conservation equations for the liquid and the surrounding gas phases. An improved volume-of-fluid (VOF) method, combined with an innovative topology-oriented adaptive mesh refinement (TOAMR) technique, was developed and implemented to track the interfacial dynamics. The complex evolution of the droplet surface over a broad range of length scales was treated accurately and efficiently. In particular, the thin gas film between two approaching droplets and subsequent breakup of liquid threads were well-resolved. Various types of droplet collision were obtained, including coalescence, bouncing, and reflexive and stretching separations. A regime diagram was developed and compared with that for Newtonian liquids. Fundamental mechanisms and key parameters that dictate droplet behaviors were identified. In addition, collision-induced atomization was addressed.

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