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Capillary-Inertial Colloidal Catapult upon Drop Coalescence ROGER CHAVEZ, FANGJIE LIU, Duke Univ, JAMES FENG, University of British Columbia, CHUAN-HUA CHEN, Duke Univ — To discharge micron-sized particles such as colloidal contaminants and biological spores, an enormous power density is needed to compete against the strong adhesive forces between the small particles and the supporting surface as well as the significant air friction exerted on the particles. Here, we demonstrate a colloidal catapult that achieves such a high power density by extracting surface energy released upon drop coalescence within an extremely short time period, which is governed by the capillary-inertial process converting the released surface energy into the bulk inertia of the merged drop. When two drops coalesce on top of a spherical particle, the resulting capillary-inertial oscillation is perturbed by the solid particle, giving rise to a net momentum eventually propelling the particle to launch from the supporting surface. The measured launching velocity follows a scaling law that accounts for the redistribution of the momentum of the merged drop onto the particle-drop complex, and is therefore proportional to the capillary-inertial velocity characterizing the coalescing drops. The interfacial flow process associated with the colloidal catapult is elucidated with both high-speed imaging and phase-field simulations.

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