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Bicomponent Droplets Spontaneously Explode upon Impact on Superheated Substrate TAMAL ROY, University of Illinois at Chicago, USA, UDDALOK SEN, University of Twente, The Netherlands, RANJAN GANGULY, Jadavpur University, India, LOUIS A. ANGELONI, W. ANDREAS SCHROEDER, CONSTANTINE M. MEGARIDIS, University of Illinois at Chicago, USA — The impact of a liquid droplet on a superheated substrate often exhibits the Leidenfrost phenomenon, where the droplet floats on a thin layer of its own vapor without contacting the underlying substrate. While droplets of pure liquids maintain their shape integrity during and after impact at Weber numbers < 50, binary droplets (containing liquids of different volatilities) may undergo a vigorous disruption (explosive boiling) in a narrow operating regime of the substrate temperature and liquid composition matrix. We have characterized the explosive boiling of ethanol-in-water droplets of different compositions over a range of the substrate temperature and Weber number in an attempt to explain the responsible physical mechanism. A scaling analysis reveals the possibility of a collapsing vapor layer underneath the droplet, thereby enforcing short-lived liquid-solid contact, which was evidenced by interferometric imaging of the bottom surface of the impacting drops during explosive events. Upon contact, local superheating of the liquid at the bottom layer of the droplet initiates flash boiling of the more volatile component (ethanol), which manifests itself as a violent disintegration of the liquid volume.

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