Abstract Submitted for the DFD17 Meeting of The American Physical Society

Transient dynamics in dynamic Leidenfrost phenomenon SANGHYEON LEE, SANG JUN LEE, JI SAN LEE, X-ray Imaging Center, Department of Materials Science and Engineering, POSTECH, South Korea, KAMMEL FEZZAA, X-ray Science Division, Advanced Photon Source, Argonne National Laboratory, USA, JUNH HO JE, X-ray Imaging Center, Department of Materials Science and Engineering, POSTECH, South Korea — When a liquid droplet impinges on a superheated surface, the droplet can form a vapor layer toward the surface and bounce back, known as dynamic Leidenfrost phenomenon. Transient dynamics of the vapor layer before the droplet bounces back can play a critical role in many industrial technologies such as power plant cooling and engine combustion, but is not fully understood mostly due to lack of appropriate visualization methods. Here, we successfully visualize the transient dynamics using ultrafast X-ray imaging. We experimentally reveal that the initial vapor dome flattens to a vapor disk, which then grows in thickness (δ)following the Fourier's heat conduction law $\delta \propto \Delta T^{0.5} t^{0.5}$, where ΔT is the temperature difference across the vapor disk and t is the time after impact. Ripples generate near the periphery of the vapor disk as long as the thickness reaches a certain value (~12.16 μ m), afterwards rapidly growing in amplitude while propagating to the center. Interestingly, rippling enhances droplet evaporation rate significantly The transient dynamics will provide import insight in understanding and modelling of power plant cooling or engine performance.

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Date submitted: 01 Aug 2017

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