

Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Vapor layer evolution during drop impact on a heated surface

SANGHYEON LEE, SANGJUN LEE, JISAN LEE, X-ray Imaging Center, Department of Materials Science and Engineering, POSTECH, South Korea, KAMEL FEZZAA, X-ray Science Division, Advanced Photon Source, Argonne National Laboratory, USA, JUNG HO JE, X-ray Imaging Center, Department of Materials Science and Engineering, POSTECH, South Korea — When a liquid drop impacts on a sufficiently hot surface above the boiling point, a vapor layer is formed between the drop and the surface, preventing direct contact between them and as a result levitating the drop, known as the Leidenfrost effect. Understanding the evolution of the vapor layer is largely unexplored despite its importance in estimating heat transfer in cooling systems of thermal or nuclear power plants. The side-profile visualization of the vapor layer, as absolutely required for investigating its evolution, has been however unavailable by conventional optical microscopy. In this study, by employing ultrafast X-ray phase contrast imaging, we directly visualize the profiles of the vapor layers during liquid drop impact on a hot surface and elucidate the evolution of the vapor layers during spreading and retraction of the drop as functions of impact height and surface temperature. We reveal that the evolution is governed by the propagation of capillary waves generated in retraction and the wavelength of capillary waves λ is inversely proportional to the impact height h with a relation $\propto \frac{\sigma}{\rho h} \propto We^{-1}$ where We is weber number. Capillary waves that converge at the center of the vapor layers are linked to the bouncing behavior of the drop.

SangHyeon Lee
X-ray Imaging Center, Department of Materials Science
and Engineering, POSTECH, South Korea

Date submitted: 24 Jul 2015

Electronic form version 1.4