Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Physics of Spreading and Arrest of Molten Liquid on Solid Substrates FARYAR TAVAKOLI, University of California, Los Angeles, STEVEN DAVIS, Northwestern University, PIROUZ KAVEHPOUR, University of California, Los Angeles — The physics of non-isothermal spreading followed by phase change, unlike universal equations established for isothermal spreading, is still a mystery. A plethora of applications such as coating technology, rapid prototyping, 3D printing and plastic electronics involve molten droplets spreading on cold substrate surfaces. Better control of these processes requires fundamental understanding of heat transfer and fluid flow that transpire during the spreading and solidification of liquid droplets. The present work focuses on the dynamic and thermal characteristics of liquid spreading and subsequent arrest. Spreading of liquid was recorded and evolution of liquid spread diameter and liquid-solid contact angle were measured from the recordings of a high-speed digital camera. After solidification initiation at the basal plane, a liquid drop is pinned to a solid substrate showing fixed footprint and contact angle. Arrested contact angle (θ^*) and arrested base diameter (D*) are evaluated against two main contributing variables: fluid flow rate and Stefan number. We have developed a power law that indicates the arrested contact angle and base diameter are not single-valued for given substrate temperature, but are strongly dependent on flow rate and the surface characteristics.

Faryar Tavakoli
University of California, Los Angeles

Date submitted: 08 Aug 2012 Electronic form version 1.4