Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

A Multiscale simulation method for ice crystallization and frost growth MIAD YAZDANI, United Tech Res Ctr — Formation of ice crystals and frost is associated with physical mechanisms at immensely separated scales. The primary focus of this work is on crystallization and frost growth on a cold plate exposed to the humid air. The nucleation is addressed through Gibbs energy barrier method based on the interfacial energy of crystal and condensate as well as the ambient and surface conditions. The supercooled crystallization of ice crystals is simulated through a phase-field based method where the variation of degree of surface tension anisotropy and its mode in the fluid medium is represented statistically. In addition, the mesoscale width of the interface is quantified asymptotically which serves as a length-scale criterion into a so-called Adaptive AMR (AAMR) algorithm to tie the grid resolution at the interface to local physical properties. Moreover, due to the exposure of crystal to humid air, a secondary non-equilibrium growth process contributes to the formation of frost at the tip of the crystal. A Monte-Carlo implementation of Diffusion Limited Aggregation method addresses the formation of frost during the crystallization. Finally, a virtual boundary based Immersed Boundary Method (IBM) is adapted to address the interaction of ice crystal with convective air during its growth.

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Date submitted: 29 Jul 2015 Electronic form version 1.4