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Direct Numerical Simulations of Frost Buildup Below Turbulent Flow MAHSA FARZANEH, Department of Mechanical and Aerospace Engineering, University of Florida, NADIM ZGHEIB, School of Engineering, Lebanese American University, S.A. SHERIF, S. BALACHANDAR, Department of Mechanical and Aerospace Engineering, University of Florida — We present results from two-way coupled direct numerical simulations of frost buildup below a turbulent open-channel air flow at $Re_\tau = 180$. We solve the conservation equations of mass, momentum, and energy along with a transport equation for vapor mass fraction. We use the immersed boundary method to account for the presence of the temporally and spatially evolving frost surface by imposing the no-slip, no-penetration boundary condition. The bottom plate, over which frost develops, is maintained at a uniform and constant temperature. Additionally, the mean bulk temperature and humidity of the turbulent flow are also kept unchanged for the duration of the simulation. By equating the temporally and spatially resolved convective and diffusive heat fluxes to the conductive flux between the frost surface and the bottom plate, we extract the time-dependent temperature at the frost surface. Furthermore, we use mass conservation of water vapor to measure the growth rate of the frost thickness over time. Our simulations are validated against laminar experimental data and could be used for comparison with future simulations or experiments of frost buildup below turbulent flow.

Mahsa Farzaneh
University of Florida

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