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Can Ice Prevent Frost Growth? SAURABH NATH, Virginia Tech, RYAN HANSEN, Oak Ridge National Laboratory, KEVIN R. MURPHY, Virginia Tech, SCOTT RETTERER, PATRICK COLLIER, Oak Ridge National Laboratory, JONATHAN BOREYKO, Virginia Tech, NATURE-INSPIRED FLUIDS & INTERFACES TEAM, CENTER FOR NANOPHASE MATERIALS SCIENCES TEAM
— So-called icephobic surfaces that exhibit special wettability characteristics can delay the onset of ice nucleation in supercooled water. However, to date no icephobic surface has been able to passively prevent frost growth once ice nucleates. Here, we demonstrate that the growth rate of frost can be tuned and even halted with a chemically patterned surface that controls the spatial distribution of supercooled condensation. The success and speed of inter-droplet frost growth is found to depend upon two primary factors: the extent of spacing between hydrophilic regions where liquid nucleation occurs and the time allowed for condensation growth prior to the initial freezing event. Instead of delaying the onset of freezing, we initiate freezing as early as possible. This creates a "dry zone" where no frost and condensation can occur. The underlying mechanism behind the "dry zone" involves the saturation vapor pressure over ice that is lower than that over water at the same temperature, causing ice to behave like a passive humidity sink. Thus, quite remarkably it appears that ice itself may be the solution to the frosting problem.

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