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Effects of Surface Wettability on the Porosity and Wickability of Frost[1] KATHERINE WITT, FARZAD AHMADI, JONATHAN BOREYKO, Virginia Tech — The wicking of liquids through porous media has been studied for many materials, but never for frost, despite its implications for arctic oil spills and oil-infused surfaces. Here, we characterize silicone oils wicking up frost sheets. A layer of frost was grown on aluminum plates of varying surface wettability: superhydrophilic, hydrophilic, hydrophobic, and superhydrophobic. Once the desired frost thickness was grown, a humidity chamber was used to maintain the frost at the dew point and the bottom of the plate was dipped in a reservoir of fluorescent silicone oil. For all surfaces, the wicking rate of the oil increased with increasing wettability. For the wetting surfaces, this is manifested in the length vs. time data following the classical Washburn equation, exhibiting a power slope of about 1/2 and resulting in a larger effective pore radius with increasing wettability. However, we observed that on the non-wetting surfaces, the discrete distribution of the frosted dew droplets resulted in a new scaling law with a slope much less than 1/2, especially for the superhydrophobic surface which promoted jumping-droplet condensation. This research shows that the wicking of oil up a layer of frost can give insight into the morphology of frost. Conversely, if the underlying wettability of a frost sheet can be controlled, the spread of oil can be widely tuned.

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