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Experiments on the Dynamic Wetting of Growing Ice JOHN LADAN, STEPHEN W. MORRIS, Dept. of Physics, University of Toronto — The morphology of ice formed from liquid water flowing over a growing surface presents a challenging free-boundary problem. We present experimental measurements of water flow on the surface of a growing icicle. The liquid water contains Sodium Fluorescein in concentrations below 168 ppm. Icicles exhibit ripples around their circumference with a near universal wavelength of 1 cm. Experiments have shown that the rippling instability is associated with small levels of impurities and is not present for sufficiently pure water. Existing models of icicle growth assume that the icicle is covered completely by a thin film of flowing water. In our experiment, the dye acts both as the instability-triggering impurity and the liquid indicator. We can clearly observe where liquid lies on the surface, and the presence of non-fluorescing dye trapped inside the ice. The icicle surface is not entirely covered by a water film, but rather is only partially wetted. The coverage and speed of the dynamic wetting depends on the topography and impurity dependent surface properties. Water flows much more readily over previously wetted areas. This incomplete coverage appears to affect the morphology of the growing icicle and may be an important component of the mechanism of ripple formation.

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