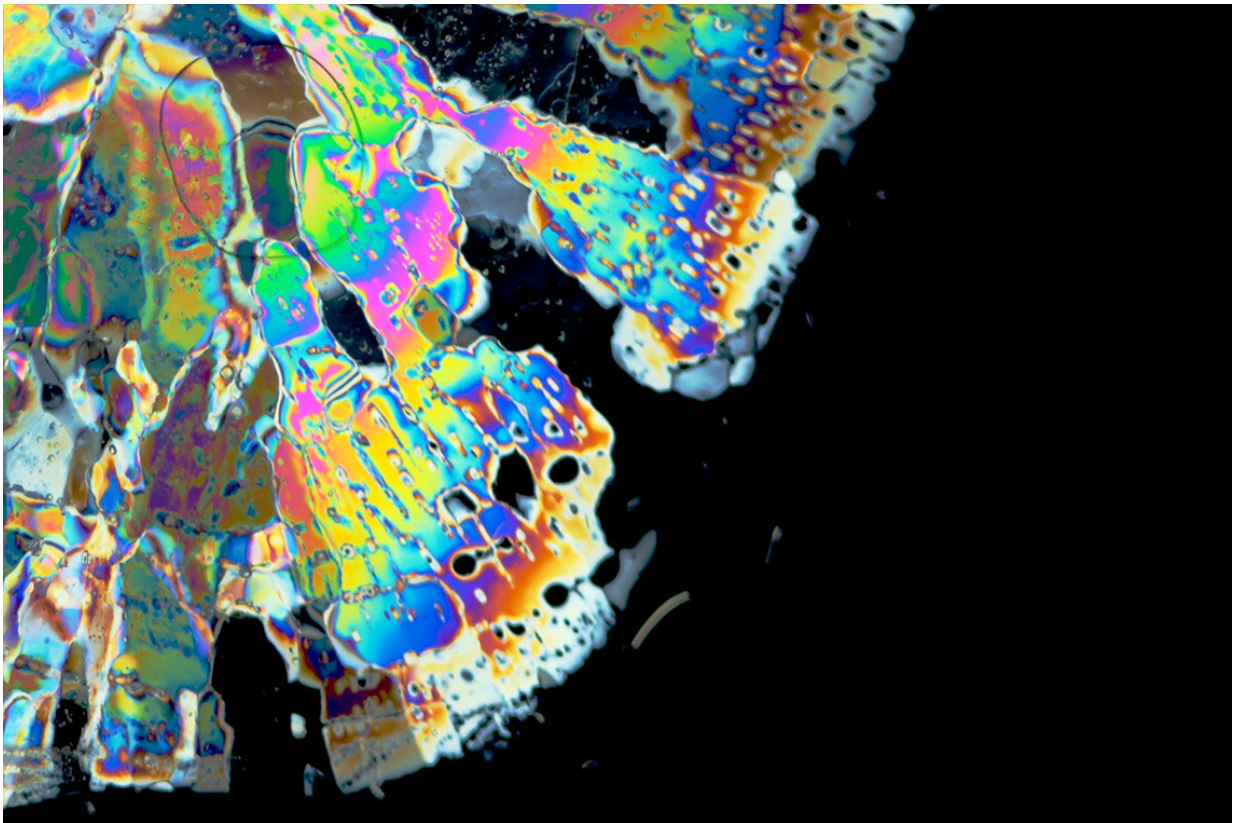


Researchers discover what causes some icicles to form with ripples

December 2 2022, by Sean Bettam



An icicle cross section under polarized light, showing the crystal structure of the ice shot through with dark regions of unfrozen, impure water. Credit: J. Ladan and S. W. Morris

Experimental physicists at the University of Toronto are closer to

understanding why some icicles form with ripples up and down their outsides, while others form with smooth, slick, even surfaces.

By growing icicles from [water samples](#) with different contaminants like [sodium chloride](#) (salt), dextrose (sugar) and [fluorescent dye](#), the researchers discovered that water impurities become entrapped within icicles as they form and subsequently create chevron patterns that contribute to a ripple effect around their circumferences.

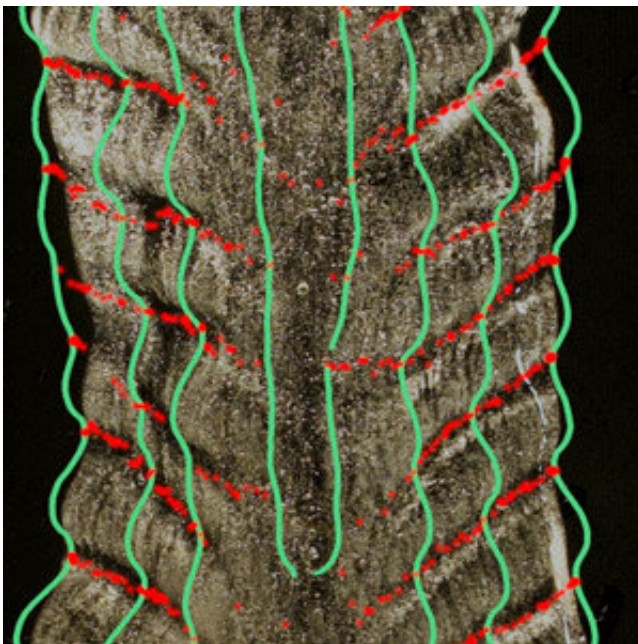
The findings were described in a study published recently in *Physical Review E*.

"Previous theories held that the [ripples](#) are the result of surface tension effects in the thin film of water that flows over the ice as it forms," says Stephen Morris, a professor emeritus in the department of physics in the Faculty of Arts & Science and a co-author of the study. "We now see that the ripple formation does not depend on surface tension. It does not even depend only on features external to the ice, but rather is connected to patterns of impurities inside the ice.

"The external shape and internal patterns are different aspects of the same—so far unexplained—problem."



A series of icicle cross sections at increasing concentration of salt. In the mid-range, a clear chevron pattern of fogginess is seen that matches up with the surface ripples. Credit: J. Ladan and S. W. Morris



The cross section of an icicle, showing the pattern of internal fogginess, overlaid by edges measured during the growth. The red dots indicate the troughs of ripples. Credit: J. Ladan and S. W. Morris

The findings build on an earlier discovery by Morris and his research team that found the presence of salt in water was responsible for the irregular, rippled shapes of icicles grown in the lab. The new results show that it is not the type of impurity that leads to the ripples, but just the fact that there is something foreign in the water.

"We tested various species of impurities and the phenomena are unchanged as long as their concentrations are similar," says John Ladan, a Ph.D. student working with Morris and lead author of the study. "This is consistent with the idea that only physical, as opposed to chemical, processes are involved."

While their motivation for unlocking the secret behind the ripples is pure curiosity about natural patterns, the study of ice growth has serious applications, including ice accumulation on airplanes, ships and power lines. However, the results show that existing engineering models of ice accretion on [power lines](#) do not account for the entire problem. The researchers note that the findings do not resolve the mechanism of the ripples, but rather just add new aspects to the phenomena to be explained.

"We get a more profound appreciation for the complexity of natural ice formations," says Morris.

More information: John Ladan et al, Pattern of inclusions inside rippled icicles, *Physical Review E* (2022). [DOI: 10.1103/PhysRevE.106.054211](https://doi.org/10.1103/PhysRevE.106.054211)

Provided by University of Toronto

Citation: Researchers discover what causes some icicles to form with ripples (2022, December 2) retrieved 2 May 2024 from <https://phys.org/news/2022-12-icicles-ripples.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.