

## **Controlling Ice Growth using Selective Infrared Radiation**

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Freezing is used to preserve cells, tissues and food for a long period of time. However, ice formation during the preservation procedure can be destructive. For example, ice recrystallization is an Ostwald ripening process, in which larger ice crystals grow on the expense of the smaller ones. This process causes damages to food and biological systems, as a result of mechanical disruptions by the growing ice crystals during freezing and thawing. To achieve a successful cryopreservation, the formation of growing ice crystals must be controlled. This research examines the implication of selective infrared (IR) radiation on ice and partially frozen systems. We propose to control and manipulate ice growth using selective IR radiation, which is absorbed by the ice more efficiently than by water. Using the selective radiation, we have found a unique ice pattern, in the shape of holes and micro-channels. Pattern formation is found in nature in many scenarios, for example: desert vegetation and skin color of animals, such as fish and zebras. Those patterns resulted from processes of reaction-diffusion. We intend to use a reaction-diffusion model to explain the special ice pattern that was observed in our system. The model will include the heat that is created by the radiation and diffuses according to the temperature gradient. The temperature determines the phase, which is also time dependent.

Based on these findings, we propose that the selective radiation can be used to depress ice recrystallization. We assume that the selective radiation will heat the larger ice crystals more than the smaller ones, and thus inhibit recrystallization. Furthermore, a known method to control ice growth is using ice binding materials. Antifreeze proteins and the synthetic material Zirconium Acetate, by binding to an ice crystal, inhibit ice growth and depress ice recrystallization. They possess ice shaping properties as well. We investigate the selective radiation in combination with ice binding materials as a method to control ice shaping, ice growth and recrystallization. The ice growth modifications and the recrystallization inhibition can be used to improve cryopreservation procedures.