Abstract Submitted
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Fast Cooling and Vitrification of Aqueous Solutions for Cryopreservation[1] MATT WARKENTIN, Laboratory of Applied and Solid State Physics, Physics Department, Cornell University, NAJI HUSSEINI, VIATCHESLAV BEREJNOV, Laboratory of Applied and Solid State Physics, Physics Department, Cornell University, ROBERT THORNE, Laboratory of Applied and Solid State Physics, Physics Department, Cornell University — In many applications, a small volume of aqueous solution must be cooled at a rate sufficient to produce amorphous solid water. Two prominent examples include flash-freezing of protein crystals for X-ray data collection and freezing of cells (i.e. spermatozoa) for cryopreservation. The cooling rate required to vitrify pure water ($\sim 10^6$ K/s) is unattainable for volumes that might contain cells or protein crystals, but the required rate can be reduced by adding cryoprotectants. We report the first measurements of the critical concentration required to produce a vitrified sample as a function of the sample's volume, the cryogen into which the sample is plunged, and the temperature of the cryogen, for a wide range of cryoprotectants. These experiments have broad practical consequences for cryopreservation, and provide insight into the physics of glass formation in aqueous systems.

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