Public Abstract
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Successful cryopreservation protocols have been developed for a limited number of cell types through extensive amount of experimentation. To optimize current protocols and to develop effective protocols for a larger range of cells and tissues it is imperative that accurate transport models be developed for the cooling process. Such models are dependent on the thermodynamic properties of intracellular and extracellular solutions, including heat capacity, latent heat, and the physical phase change temperatures. Scanning techniques, such as differential-scanning calorimetry (DSC) and differential thermal analysis (DTA), are effective to obtaining thermodynamic properties.

Conventional thermal scanning tools require sample sizes that are multi-celled in nature. An issue with tools that require multiple cells is that responses that could reveal intrinsic behavior of individual cells are effectively masked. It is hypothesized that evaluating thermodynamic properties of individual cells will allow more fundamental understanding of cell-level transport, and lead to more effective cryopreservation protocols.

To detect a phase change within a prototypical mouse oocyte cell (~100 Âµm diameter) sample holders for the scanning tools must be on the same order of size as the cell to reduce the relative thermal mass of the sample holder and to ultimately improve the measurement sensitivity. A proof-of-concept DTA sample holder with a 'bowl' to cradle the cell has been designed and fabricated using micro-electrical mechanical systems (MEMS) manufacturing techniques. Control software has been developed which is capable of providing any desired heating or cooling profile within a humidity controlled environment. Detection of freezing and thawing temperatures, heat capacity, and latent heat from a single oocyte cell is demonstrated. Repeatable scans of water and cryoprotectant solutions have also been demonstrated.