

MICROFABRICATION AND MODELING OF A TOOL FOR THERMODYNAMIC
CHARACTERIZATION OF MICRO-SAMPLES

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ABSTRACT

Cryopreservation is the process of preserving biological samples indefinitely at subzero temperatures. Successful cooling procedures have been developed for a limited number of cell types through an extensive amount of experimentation. In order to optimize further cooling procedures for a larger range of cells and tissues it is important to develop accurate models utilizing the thermal dynamic properties of cells which can help eliminate further costly experiments. Differential scanning analysis is an effective method for characterizing biological samples.

In order to detect a phase change within an oocyte cell (100 μm diameter) the DTA must be on the same order of size or lower as the cell to achieve maximum sensitivity. To achieve minimization of the DTA, a proof-of-concept DTA bridge with crucible has been designed and fabricated using micro-electrical mechanical systems (MEMS) manufacturing techniques. LIGA is one technique that was utilized to create a sacrificial micro-mold to allow growth of copper of the desired geometry using electro-deposition. Utilizing a custom made test section which achieves linear cooling profiles from ambient to -50 C and controlled humidity environment; detection of freezing and thawing temperatures, heat capacity, and enthalpy of unit mass can be detected and calculated from a single oocyte cell.