Public Abstract
First Name:James
Middle Name:Lee
Last Name:Armes
Adviser's First Name:Gary
Adviser's Last Name:Solbrekken
Co-Adviser's First Name:
Co-Adviser's Last Name:
Graduation Term:FS 2013
Department:Mechanical & Aerospace Engineering
Degree:MS
Title:EXPERIMENTAL DESIGN AND MODELING OF A MICROSCALE DIFFERENTIAL THERMAL CALORIMETER FOR THE PURPOSES OF CRYOPRESERVATION

In order to develop successful cryopreservation protocols for various biological materials, it is necessary to determine the thermodynamic properties of nanoliterscale biological samples: ranging from heat capacity to heat of fusion. Differential thermal analysis is a calorimetric technique which is efficacious at determining these thermodynamic properties and will help lend insight into the formation of intracellular ice which depends heavily on the rate at which the sample is cooled. If too much intracellular ice is formed during the cooling process, the biological material can be destroyed. To investigate the effects of a range of cooling and warming rates on a cell, a control system and data acquisition software has been developed for use with a custom microfabricated differential thermal analyzer (microDTA). Utilizing either an apriori prediction of the microDTA's thermal response or an integrated software-based PID control system, the program developed allows for precise control over the cooling and warming rate of the microDTA. In order to enhance the accuracy of the a-priori predicted current profile, a 2D numeric model was developed of the ?DTA. This model also has allowed for geometric optimization to be performed on the next generation prototype of the microDTA. The microDTA has been shown to accurately measure the freezing point and heat of fusion of deionized water samples, with sample volumes on the order of nanoliters. The heat capacity of dimethyl sulfoxide(DMSO) has also been experimentally determined.