Modulated Temperature Differential Scanning Calorimeter Specifications

Temperature range: -90°C to 500°C, using mechanical cooling. The materials which will be analyzed exhibit transitions in the -90→ -70°C range. As such, the instrument shall be capable of measuring stable heat flow starting at -90°C. This temperature range shall be accomplished through the use of mechanical cooling (no LN2 required). This is a critical requirement of the research and as such shall be demonstrated and/or documented in the literature for the instrument to be considered.

Modulated-Temperature DSC: 1) The instrument shall be capable of performing MT-DSC experiments over the entire temperature operating range and shall be capable of performing these experiments in heating, cooling, or pseudo-isothermal modes (pseudo-isothermal is defined as an average isothermal temperature with superimposed modulation). The pseudo-isothermal mode is critical for our research, as NASA intends to study time-dependent effects on heat capacity at isothermal temperature.

2) The user shall be able to monitor both the raw signals, as well as the deconvoluted signal [including heat capacity, total heat flow, heat flow phase, modulation-dependent (heat capacity) heat flow, and modulation-independent (kinetic) heat flow] in real time, while the experiment is being performed. Examples of data containing all of these signals shall be presented, and the ability to produce these signals in real time, while the sample is being measured, shall be documented.

3) The modulated temperature profile shall be a regular, periodic function of known amplitude and frequency to ensure steady state control during the experiment, as well as experimental reproducibility. Random temperature perturbations are less reproducible and as such are not acceptable for our research.

Robotic Autosampler: Because this instrument will be used extensively, and often on a 24 hour basis, it shall come equipped with a robotic autosampler containing at least 35 sample positions. In addition, as the sample pans employed may vary from run to run, the autosampler shall also be capable of exchanging the reference pan (at least three positions). The calibration of this autosampler shall be automated such that a typical user can fully calibrate the system in less than 5 minutes. This performance will be verified through marketing literature.

Cell Replacement: Due to the anticipated heavy use of this instrument, it may be necessary to periodically replace the DSC transducer cell. This replacement shall be accomplished by the user, without the need for a service visit. The instrument shall also accommodate specialty cells, such as a high-pressure cell, as it may also be used to study super-critical reactions. These specialty cells shall be user-replaceable, and require little or no special installation.

Purge Gas Control: The DSC should include digital mass flow controllers for at least two separate purge gases, such that the purge gas can be automatically switched via software during the experiment. The flow rate shall also be adjustable via software during an experiment. The flow rates shall be data logged into the resulting data file.

Software: As this DSC will be used by numerous researchers, it is critical that the analysis software be installed on multiple computers. As such, the analysis program shall be un-keyed, and shall include a site license such that it may be installed on an unlimited number of computers within NAME. The data file format shall easily allow sharing/transfer of data files as individual electronic documents, which are readable by the same data analysis package. The

data analysis program shall also include a .pdf generator, for the efficient export of analyzed plots. These capabilities shall be demonstrated for product acceptance.

The MT-DSC shall also include operating software which allows for the instrument to be fully calibrated and verified automatically, without the need for operator presence. Calibrations shall include baseline, cell constant, and temperature. Scheduling capabilities shall be present, such that these calibrations and/or verifications can be programmed to perform during normal quiescent periods, such as overnight or on weekends. The software shall also be capable of sending automatic communications as to the status of these calibration/verification experiments, either by email or instant messaging, so that the operator is fully apprised of their status.

In addition, the instrument software shall be capable of performing a series of auto-diagnostic tests, either manually or through the scheduling component. These tests should verify the performance of various instrument components such as autosampler/autolid motors, electronic boards, mass flow controllers, etc. The results of these tests should be logged and the option to automatically report the result via email or instant messaging should be included.

The operating software shall also be capable of periodically and automatically checking for updates via an internet connection, and downloading/installing those updates if desired.