

## Specifications

The Naval Research Laboratory (NRL) has a requirement for a differential scanning calorimeter (DSC) with extremely high sensitivity and an Isothermal Titration Calorimeter (ITC) for use in research environments per the following specifications:

### Differential Scanning Calorimetry

- **Temperature range:** -10°C to 130°C using active Peltier heating and cooling. The instrument must be capable of automatic detection of freezing within the cell, and upon detection of freezing, the instrument must automatically begin heating the cell to avoid damage.
- **Scan Rate:** The scan rate must allow for a range between 0.1°C to 2°C/minute
- **Short-term Noise:** The DSC must have a short-term noise level of not more than 0.2µcal/min or 0.015µWatts.
- **Baseline Repeatability:** It is essential that the baseline repeatability exhibit not more than a standard deviation of 0.4µcal/min or 0.028µWatts.
- **Pressure Perturbation Calorimetry (PPC):** The DSC must include a built-in and automatic manostat capable of providing up to 6 atmospheres of pressure and the ability to measure the volumetric properties of biopolymers in dilute solutions providing a relationship to the structure and the volume capacity as well as biopolymer solvation.
- **Response time:** The instrument must have a fast halftime response of 5 seconds.
- **Heat Measurement Type:** The instrument must use power compensation methodology. The temperature difference between the sample and reference cells must be maintained below zero by applying an appropriate power difference to the two cells by using electric heaters controlled by a feedback control algorithm and power compensation bridge.
- **Cell Type, Geometry and Volume:** The cell must be continuous platinum capillary with an active volume of at least 0.25ml in order to delay onset of protein aggregation once it has unfolded, to allow cleaning of the cell using a variety of chemicals or sample buffers, and to prevent waste of expensive samples.
- **De-gassing Station:** The instrument must come with a large capacity de-gassing station capable of de-gassing up to 200ml of sample buffers. It must be equipped with a magnetic stirrer, automatic timer and separate vacuum pump.
- **Software:** Numerous researchers will use this instrument and it is critical that the analysis software be installed on multiple computers. The analysis program must be un-keyed and such that it may be installed on an unlimited number of computers. The data file format must easily allow sharing/transfer of data files as individual electronic documents, which are readable by the same data analysis package. The software must be able to i) export the raw data into an MS-Excel spreadsheet, ii) convert the raw data into Molar Heat Capacity and iii) allow loading of Molar Heat Capacity data from an alternate ASCII data file. In addition, the software must be able to perform deconvolution of the Molar Heat Capacity and Excess Heat Capacity using a variety of fitting models including: General Fit, Two-State Fit, Two-State Scaled Fit, DNA Melting profile, and Sox-DNA Model.

### **Isothermal Titration Calorimeter**

Temperature range from 2 to 80°C and temperature stability of  $\pm 0.0002^\circ\text{C}$

- Minimum detectable heat of 0.1  $\mu\text{J}$  and maximum detectable heat of 10,000  $\mu\text{J}$
- Baseline stability of  $\pm 0.02 \mu\text{cal/sec/hr}$
- Noise level of 0.004  $\mu\text{Watt}$
- Response time of 12 seconds
- Nominal cell volume of 1.0ml. The cell geometry must have conical top and bottom cells to accommodate easier filling and cleaning. The conical cells must auto align the syringe needle to assure even and constant stirring of the solutions, allow the syringe needles to be set at the lowest point of the cell, and reduce the problems associated with the formation of bubbles during filling.
- Cell material of 24K gold
- Precision burette syringes of 100 $\mu\text{l}$  and 250 $\mu\text{l}$
- Volume increments of 1-15  $\mu\text{l}$