SII NanoTechnology Inc.

DSC AS PROBLEM-SOLVING TOOL: CHARACTERIZATION OF LIPIDS

Problem

A customer in a pharmaceutical R&D center wishes to characterize the thermal transitions associated with lipids. This requires the use of an ultra high sensitivity DSC since the pre-transition thermal event associated with the lipid system is particularly weak and difficult to detect, especially for more dilute solutions.

Solution

The Seiko EXSTAR DSC6100 provides the following features for the characterization of lipids:

- ultra high sensitivity
- stable baseline
- excellent subambient performance
- wide temperature range (-150 to 500°C)
- ease of use.

Lipids are materials which, when placed in solution, form bilayer molecular structures known as liposomes. Lipids are widely utilized for pharmaceutical applications since they tend to mimic the properties of epidermal tissue and can function in drug delivery systems. When heated, lipids in solution will exhibit a main melting transition and may also yield a weak pre-transition event just below the main melting transition. The detection of the pre-transition event requires the use of a very high sensitivity DSC, such as the DSC6100.

A DPPC lipid was placed into aqueous solution such that the original, 'standard' concentration was 16 mg/mL. This solution was then diluted by a factor of 10. The dilute solution was then further diluted by an additional factor of 10. The latter solution has a dilute factor of 100 times less than the original 'standard' solution.

The dilute DPPC solution (10X dilution) and the very dilute solution (100X dilution) were analyzed on the Seiko ultra high sensitivity DSC. Approximately 55 mg of solution were placed in the 70 µL aluminum sealed containers. A reference container was prepared which contained 55 mg of pure water. The solutions were heated from 0°C to 60°C at a rate of 1°C/min. The DSC cell was cooled to 0°C using a cooling can filled with ice. The use of ice as a cooling medium cools the DSC cell to a sufficiently low temperature without the danger of freezing the solution and thereby destroying the liposomes.

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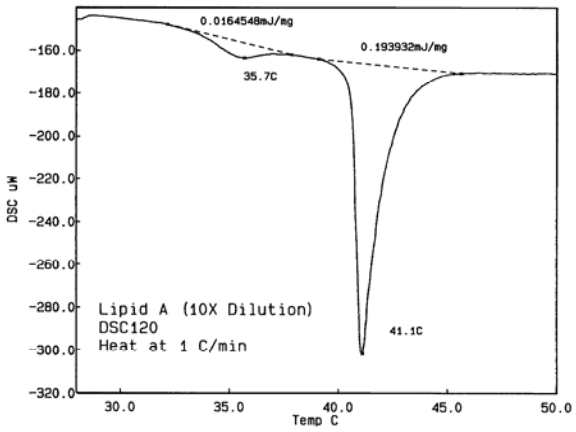

Figure 1

Shown in Figure 1 are the results obtained from the Seiko DSC on the dilute lipid solution (10X dilution). Excellent, noise-free results are obtained on this dilute solution and the two transition are observed: the main melting transition at 41.1°C with a heat of melting of 0.194 mJ/mg of solution and the weak pre-transition event at 35.7°C with a heat of transition of only 0.016 mJ/mg of solution.

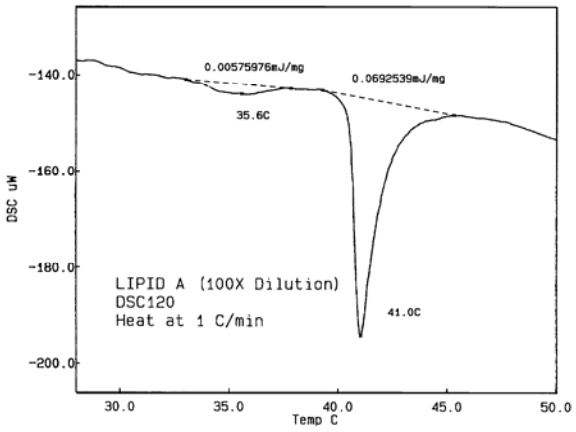

Figure 2

Displayed in Figure 2 are the results obtained on the very dilute (100X dilution) lipid. Even at this tremendous dilution, the Seiko ultra high sensitivity DSC has the ability to detect the weak pre-transition event at 35.6°C. The heat of transition is only 0.0058 mJ/mg. The main melting event associated with this lipid solution is observed at 41.0°C with a heat of melting of 0.069 mJ/mg of solution.

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A direct overlay of the DSC results obtained on the 10X and 100X diluted lipids is shown in Figure 3 for comparative purposes.

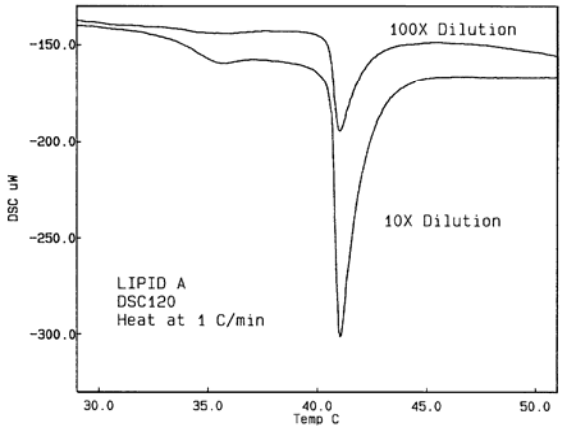

Figure 3

Summary

The analysis of lipids requires the use of a DSC which has very high sensitivity, especially for the detection of the weak pre-transition event. The Seiko DSC6100 provides the necessary degree of high sensitivity coupled with ease of use and stable baseline performance.

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