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TEMPERATURE DEPENDENCE OF THE RAMAN SPECTRA OF AMORPHOUS GLUCOSE

S. Söderholm [1], N. Meinander [1], and Y. H. Roos [2].

[1] University of Helsinki, Finland
[2] University College, Cork, Ireland

Low molecular weight carbohydrates, such as glucose, form amorphous structures in biological materials. Depending on the storage conditions, the amorphous carbohydrates are either in a solid, glassy or in a supercooled liquid state. The transition between these two states is referred to as the glass transition. When the material transforms from the glassy to the supercooled liquid state over the glass transition temperature range, molecular mobility and the rate of diffusion controlled reactions increase rapidly.

The purpose of the present study is to characterise the glass transition and molecular mobility of anhydrous amorphous glucose using Raman spectroscopy. Raman spectra for amorphous glucose over the temperature range 15 - 55 °C are reported. Amorphous glucose was prepared by melting and quench cooling as described in [1].

Two-dimensional correlation spectra and least square analyses of the spectra were used to analyse the temperature dependencies of the spectra. A clear indicator for the glass transition in amorphous glucose appears to be the intensity of the ν(O-H) stretching bands in the 3000 - 3500 cm^{-1} range, as shown in Figure 1a. The increasing intensity of the ν(O-H) vibration suggests a weakening of the hydrogen bond network as a result of the glass transition.

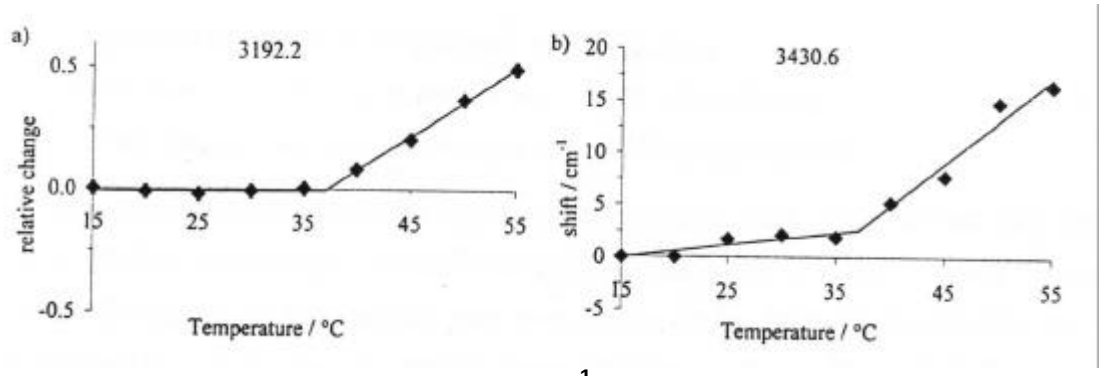

Figure 1: a) intensity change in the 3192.2 cm^{-1}, and b) wavenumber shift in the 3430.6 cm^{-1} band

The increasing frequency of the 3431 cm^{-1} band shown in Figure 1b suggests a decreasing strength of the hydrogen bond network and, therefore, higher molecular mobility with increasing temperature.

Raman spectroscopy data suggest that the glass transition can be taken as approximately Tg = 35 °C corresponding to the calorimetric glass transition.

References:

1. S.Söderholm, Y.H.Roos, N.Meinander and M.Hotokka, *J. Raman Spectrosc.* 30, 1009, 1999.