

Complex Heat Capacity of Non-Debye Process in Saccharides

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Avoiding ice nucleation and crystallization, vitrification by using the cryoprotective agents has been considered as the most promising technique to achieve cryopreservation of biological materials. Since saccharides have a strong affinity to water and less toxicity to biological substances, they have been widely used as ice crystallization inhibitors both in artificial and in nature. To study glass transitions, the numerous investigations have been done by Differential Scanning Calorimetry (DSC). Further technical improvements provide a great advantage in the measurement of frequency dependent heat capacity. In the present study, the method of Modulated-Temperature Differential Scanning Calorimetry (MDSC) was used to provide new insights into both glass transitions and relaxation processes during the glass transition events of saccharides. From the measurement in frequency dependence of complex heat capacity, MDSC can be performed as a spectroscopic probe of studying glass transitions. The significant slow cooling and heating rate were used to eliminate the deviation of complex heat capacity between different thermal processes which common in glass transitions. Therefore, the curves of real and imaginary parts of the heat capacity show the coincidence with heating and cooling processes. The information given by the enthalpy relaxation has much quantity compared with the other relaxation probes, since it relates to all degree of freedom of motions. As a result, we determined the intrinsic non-Debye parameters come from the enthalpy relaxation in the vicinity of glass transition temperature.