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# The Anti-Frozen Attribute of Sugar Solutions

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## Abstract

Low-temperature Raman spectroscopy revealed that sugar solvation depresses the critical temperature for homogeneous ice nucleation ( $T_N$ ) whose depression extent follows the order of: trehalose > glucose > fructose at the same concentration and the extent of  $T_N$  depression for a specific sugar is proportional to its concentration. We attribute the  $T_N$  depression to the O:H vibration mode redshift induced by the solute dipolar polarization and distortion of the solvent hydrogen bond (O:H-O or HB with “:” being the electron lone air of oxygen). The O:H phonon redshift lowers the Debye temperature of the O:H specific heat and disperses the quasisolid-phase boundary and the associated  $T_N$ .

**Keywords:** sugar; hydrogen bond; cryoprotection; Raman spectroscopy

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