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Influence of cation size on the low-temperature heat capacity of alkaline earth metasilicate glasses

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Abstract

The heat capacities of Sr and Ba metasilicate glasses and of a Mg silicate glass with only 44 mol% SiO_2 have been measured between 2 and 300 K with the Quantum Design Physical Property Measurement System. The derived vibrational entropies S_{298}-S_0 are 50.90, 61.00, and 36.65 J/(mol·K) for $Sr_{0.5}Si_{0.5}O_{1.5}$, $Ba_{0.5}Si_{0.5}O_{1.5}$, and $Mg_{0.56}Si_{0.44}O_{1.44}$ glasses, respectively. Along with available data for Mg- and Ca-bearing glasses, these results indicate a regular variation of the partial molar vibrational entropy of the metal oxide as a function of the ionization potential of the cation. At very low temperatures, however, the excess heat capacity of barium metasilicate glass relative to Debye limiting T^3 law is stronger than expected from such a trend, whereas $Mg_{1.12}Si_{0.88}O_{2.88}$ is the known glass whose C_P deviates the less from this law.

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