The relationship between low-temperature excess heat-capacity and physical properties in ZnO-P2O5 glasses

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The low-temperature heat-capacity of glassy material shows a deviation from Debye $T^3$ law, meaning that $C_p/T^3 - T$ plot reveals the excess heat capacity, so-called “boson peak” [1]. Several researchers have investigated the relationship between boson peak and material structures. However, origin of boson peak is unknown. The binary ZnO-P2O5 glass system is known for having unique characteristics, for example, although physical properties such as density are shown simple behavior with glass composition, glass transition temperature has extremal value. [2]. In this study, we measured low temperature excess heat-capacity of $x$ZnO-(100-$x$)P2O5 glasses in order to clarify the relationship of the boson peak to physical properties of oxide glasses.

Figure 1 shows the Non-Debye excess heat-capacity of the studied zinc phosphate glasses. As seen in Fig. 2, decrease in the amplitude of boson peak, $C_p/T^3$, and shifts of peak positional, $T_{\text{max}}$, to the high temperature were dependent on monotonically increasing ZnO content. This composition dependence of the boson peak related to simple parameters such as density rather than glass transition temperature.


![Fig. 1. Non-Debye excess heat-capacity of the studied zinc phosphate glasses.](image)

![Fig. 2. The compositional dependence of the peak position and the amplitude of the boson peak.](image)