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ACCEPTED MANUSCRIPT

Low-temperature excess heat capacity and boson peak of mixed alkali effect in borate glass

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Highlights

- **Excess heat capacity Cp of mixed alkali effect (MAE) of borate glass was studied.**
- **A broad peak of Cp /T3 with the maximum Tmax was observed in the range 5-15 K.**
- **The MAE was observed in the relation between the alkali cation size and Tmax.**
- **The MAE was observed in the universal nature of the master plot of Cp/T3.**

Abstract

When two dissimilar kinds of alkaline ions are used to co-doping oxide glass, a maximum in the electric resistivity or the expansion coefficient appears, that is called the mixed alkali effect. The heat capacity C_p of several rapidly-quenched mixed alkali borate glass was measured using a relaxation calorimeter to investigate the mixed alkali effect. A broad peak of C_p/T^3 was observed with the maximum T_{max} in the range 5-15 K, which is related to the excess vibrational density of states (VDoS) of a non-Debye nature. Such a peak is called the boson peak and it is also observed as the low-energy peak of inelastic neutron and light scattering experiments. The negative deviation from the linear relation of single alkali borate glasses between the alkali cation size and T_m was clearly observed in a mixed lithium cesium borate glass. The mechanism of this deviation was discussed on the basis of the changes in the BO_4 units and the nonbridging oxygens by co-doping. The universal nature of the master plot of C_p/T^3 also shows the deviation from that of pure borate glass by the mixed alkali effect.

Keywords: Excess heat capacity; borate glass; mixed alkali effect; boson peak

1. Introduction

The structure of the pure B_2O_3 glass consists of randomly connected planar BO_3 triangles and most of the BO_3 units are connected to form boroxol rings~~, therefore, the coordination number of boron is three~~. The pure

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