

ISSN 0128-8393



MASS

JOURNAL OF SOLID STATE SCIENCE AND TECHNOLOGY LETTERS

VOL. 13, NO. 2 (Supplementary) September 2006

The 2nd International Conference on
Solid State Science and Technology
4-6 September 2006
Grand Continental Hotel, Kuala Terengganu,
Terengganu Darul Iman, MALAYSIA

The Malaysian Solid State Science and Technology Society
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87 ACOUSTIC AND THERMAL VIBRATIONAL BEHAVIOR OF RARE EARTH
GLASSES
(P54)

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Keywords: *Metaphosphate glasses, acoustic, thermal expansion*

Introduction

Metaphosphate is a very rare composition, it is resistive to water: a valuable feature for device applications. These glasses find applications in the manufacture of magneto-optical devices, such as magnetically tunable lasers, amplifiers and frequency converters for the telecommunication industry [1]. To test predictions of the soft potential model (SPM) for the acoustic and thermal properties of cerium metaphosphate glasses, the ultrasonic wave velocity and the thermal expansion have been measured as functions of temperature and pressure.

Methodology

The rare earth glass samples were prepared from melts of mixtures of 99.9% purity grades of dry cerium oxide and phosphorous pentoxide, in an alumina crucible [2]. The ultrasonic wave velocity and attenuation were measured as a function of temperature using the pulse-echo-overlap technique [3]. The changes in ultrasonic wave velocity with pressure were measured under hydrostatic pressures. The thermal expansion was determined using a capacitance dilatometer.

Discussion

Compressions $V(P)/V_0$ of the rare earth metaphosphate glasses at 293K are similar to that of vitreous SiO_2 . At comparatively low pressures the compressions are similar, but for vitreous SiO_2 the curve diverges slowly due to the negative sign of $(\partial B^3/\partial P)_{T,P=0}$. The linear thermal coefficient $\alpha(T)$ data measured for $\text{Ce}_2\text{O}_3)_{0.254}(\text{P}_2\text{O}_5)_{0.746}$ glass compared with those for $(\text{Sm}_2\text{O}_3)_{0.248}(\text{P}_2\text{O}_5)_{0.752}$ and $(\text{La}_2\text{O}_3)_{0.222}(\text{P}_2\text{O}_5)_{0.778}$ glasses. The binary $(\text{Sm}_2\text{O}_3)_{0.248}(\text{P}_2\text{O}_5)_{0.752}$ glass has the smallest linear thermal expansion at all temperatures, attaining a value of only $\sim 5 \times 10^{-6} \text{K}^{-1}$ at 300K; that of $(\text{La}_2\text{O}_3)_{0.222}(\text{P}_2\text{O}_5)_{0.778}$ is rather larger. The thermal expansion coefficient of the $(\text{Ce}_2\text{O}_3)_{0.254}(\text{P}_2\text{O}_5)_{0.746}$ glass is intermediate between those of the other two REMG. When pressure is applied, the compressions $V(P)/V_0$ of the glasses with negative $(\partial B^3/\partial P)_{T,P=0}$ such as europium metaphosphate glasses display a stronger volume effect under compression as compared with the rare earth metaphosphate glasses.

The wave velocity and thermal expansion of cerium metaphosphate glasses have been studied as a function of temperature and pressure. The results obtained provide the physical origin of the vibrational anharmonicity of the glasses and are in agreement with predictions of the potential model (SPM).

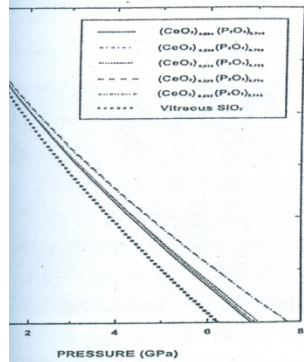


Figure 1 Compression $V(P)/V_0$ vs Pressure (GPa)

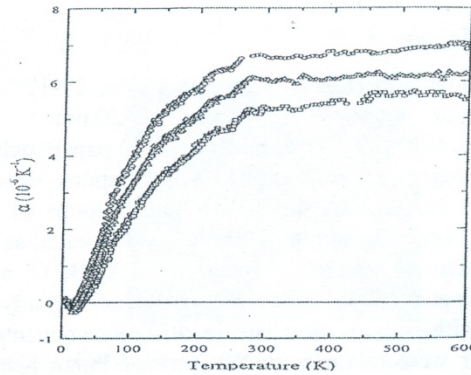


Figure 2 The linear thermal coefficient $\alpha(T)$ measured with pressure

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ACOUSTIC AND THERMAL VIBRATIONAL BEHAVIOR OF RARE EARTH GLASSES (P54)

Kancono, W

Abstract

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