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Temperature dependent EXAFS study on local structure around additive elements M in $Ge_{15}Te_{80}M_5$ (M=Cu, Ag and In) glass

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Introduction

It has been found that the glass-forming ability of bulk $Ge_{15}Te_{85}$ glass is enhanced by replacing Te with about 5 % metals such as Cu and Ag, and suppressed with In. The bonding between these additive metals and Ge or Te play an important role in the glass forming ability and the stability of glasses. In the former studies, we have reported the different static local structure around additive elements M in $Ge_{15}Te_{80}M_5$ (M = Cu, Ag, In) glass[1,2]. In this report. we present recent results of EXAFS analysis for different temperature dependence of the local structure around Ag and In in $Ge_{15}Te_{80}M_5$ glass.

Experimental

Samples were prepared by the melt-quenching technique. Quarts ampules were heated to 1300K for 0.5 hours and then kept 1100K for 48 hours, then subsequently quenched in an ice-water mixture. The amorphous nature of the samples was confirmed via x-ray diffraction.

Ag and In K-edge XAFS spectra were measured using transmission mode at the BL10B station with channel-cut Si(311) monochromator. Storage ring energy and current were 3GeV and 160-180 mA, respectively. Sample temperature was varied from 20 to 298K.

Results and discussion

Figure 1 shows temperature dependence of k^3 weighted Fourier transform of Ag K-edge EXAFS for $Ge_{15}Te_{80}Ag_5$ glass. According to the disordered structure of $Ge_{15}Te_{80}Ag_5$, one main atomic correlation peak is observed at 2.5Å without long distance correlation peaks. This peak at 2.5Å is attributed to the Ag-Te correlation[2]. The height of main peak is decreased with increasing sample temperature.

Radial structure functions (RSF) of In atoms show similar feature with that of Ag atoms; i.e. only one main correlation peak exist at 2.6Å without longer distance correlation peaks, as seen in figure 2. This main peak in RSF for $Ge_{15}Te_{80}In_5$ glass also attributed to In-Te correlation[2].

The temperature dependence of the RSF peak for the In-Te, however, is different from that for the Ag-Te. The Ag-Te correlation is rather largely decrease with increasing sample temperature. The bonding nature of the Ag-Te is ionic in Ag-Te intermetallic compound, while that of In-Te is covalent. Therefore, it is suggested that these different bonding nature cause different temperature dependence of RSF peaks of EXAFS. Quantitative analysis for these RSFs of Ag and In, and EXAFS analysis for other elements, i.e. Ge, Te and Cu, are under progress.

References

[1] F. Kakinuma et al, PF Activity Report, #16 (1998)152.
[2] M. Sakurai et al., J. Non-cryst. Solid., 312-314 (2002) 585.

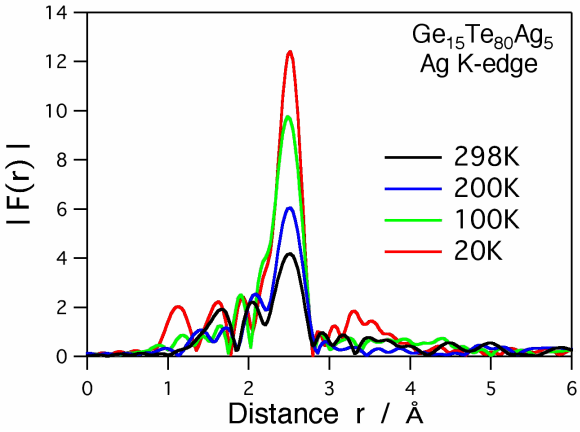

Fig.1 Temperature dependence of k^3 weighted Fourier transform of Ag K-edge EXAFS for $Ge_{15}Te_{80}Ag_5$ glass.

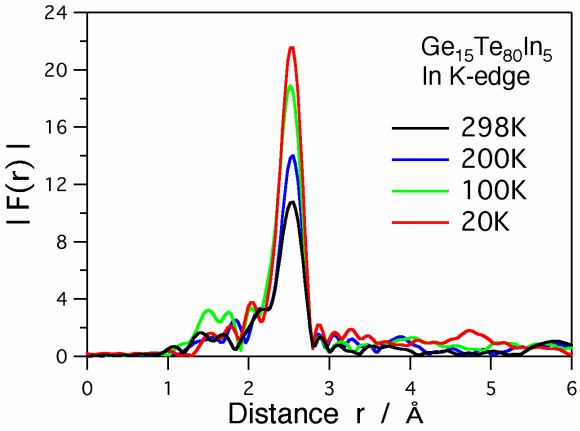

Fig.2 Temperature dependence of k^3 weighted Fourier transform of In K-edge EXAFS for $Ge_{15}Te_{80}In_5$ glass.

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