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Ionic Conduction and Local Structure in AgI-As_2Se_3 Glasses

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Introduction

Many kinds of studies for ionic conducting glasses, especially for AgI-doped glass systems, have been carried out from academic and practical points of view. Recently, it was demonstrated that the $(AgI)_x(As_2Se_3)_{100-x}$ glass powders have been successfully obtained up to 70 mol% AgI content by the mechanical milling method [1]. Furthermore the progression of amorphization and the appearance of fast ionic conduction in $(AgI)_x(As_2Se_3)_{100-x}$ system have been reported. This paper will present results of XAFS experiments in AgI-As_2Se_3 glasses and discuss the local structure in AgI doped non-oxide glasses.

Experimental procedure

$(AgI)_x(As_2Se_3)_{100-x}$ (x = 40 and 60) samples were prepared at room temperature by means of the mechanical milling method (milling time = 0, 0.5, 1, 2, 10, 20 and 40 hours) using a planetary ball mill equipment.

EXAFS studies for amorphous samples were carried out at BL-12C (for As and Se K-edges) and NW10A (for Ag and I K-edges) stations in KEK. The intensity of the incident beam, I_0, and that of the transmitted beam, I, were measured using ionization chambers. The measurement temperature was set to be 20K.

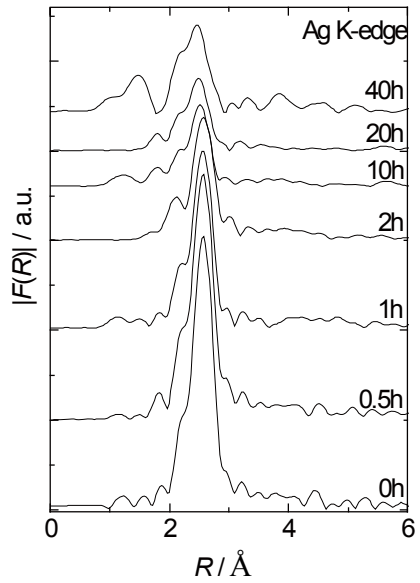

Fig. 1 Magnitude of Fourier transformation of the EXAFS oscillation function at the Ag K-edge for $(AgI)_{40}(As_2As_3)_{60}$ glass.

Results

Figure 1 provides the magnitude of the Fourier transformation, $|F(R)|$, of the EXAFS oscillation function at Ag K-edge for the $(AgI)_{40}(As_2Se_3)_{60}$ samples at the different milling stages. The position of a main peak in $|F(R)|$ shifts slightly to shorter R with increasing milling steps. The intensity of this peak significantly decreases, implying the decrement of the coordination number of iodine atoms around the mobile Ag ions. These tendencies are reasonably confirmed by the result for I K-edge EXAFS data.

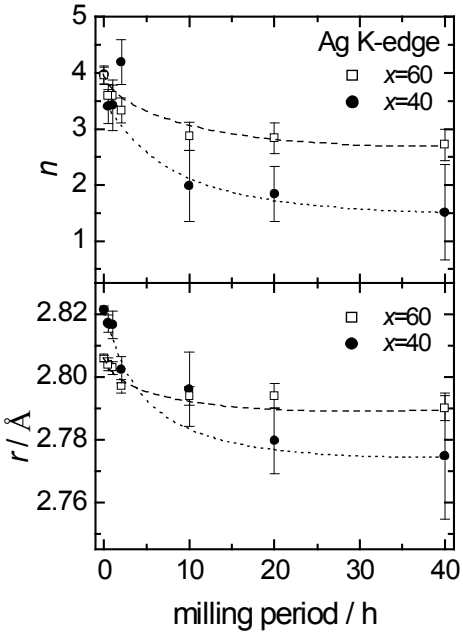

Fig. 2 Milling time dependence of the interatomic distance and the coordination number of Ag-I pairs in $(AgI)_x(As_2Se_3)_{100-x}$.

The milling time dependences of the interatomic distance, $r_{Ag\text{-}I}$, and the coordination number, $n_{Ag\text{-}I}$, of Ag-I pairs are illustrated in Fig. 9. The $r_{Ag\text{-}I}$ and $n_{Ag\text{-}I}$ decrease clearly with increasing milling time in both 40 and 60 mol% AgI samples. The apparent decrease of coordination number of Ag-I pairs corresponds to the disordering of Ag ions in the glass (or distortion of AgI units in the glass matrix), which might be strongly related to the appearance of fast ion conduction in the present glass system. This opinion can reasonably be supported by the previous results of diffraction experiments for the same systems.

References

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