Structural analysis of amorphous thin film of IZO by grazing incidence X-ray scattering

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Amorphous IZO (In_2O_3/ZnO_2=90/10wt%) films have high transparency in the visible range and high electrical conductivity. IZO is one of the candidate materials of transparent conductive oxides for use as transparent electrodes of flat panel displays such as liquid crystal displays. It is very important to reveal the relationship between conductivity and structural features of the IZO films, therefore grazing incident X-ray scattering (GIXS) measurements were carried out in order to investigate amorphous structures of IZO films.

Film samples were prepared by sputtering method on Si substrates. Measurements of GIXS were performed using the multi-axes diffractometer at BL46XU facility. Energy of the incident X-ray was set at 20 keV. Samples were set at an angle of 0.11 degrees to the incident x-ray. The radial distribution functions (RDF) were obtained by fourier transformation of X-ray scattering profiles.

Figure 1 shows the RDF of amorphous In_2O_3 film. The RDF has two peaks assigned to the nearest neighbor of In-In pairs; one corresponds to the corner shared In-In (peak A) and the other corresponds to the edge shared In-In (peak B). The intensity ratio of the peak A to the peak B in the RDF of amorphous IZO film was higher than that of amorphous In_2O_3 film. This was considered to be the peculiarity of amorphous structure in IZO film.

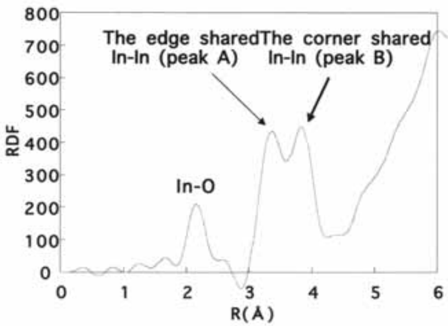

Figure 1 Radial distribution function of amorphous In_2O_3 film.

Observation of long-period magnetic structure in chiral two-dimensional ferrimagnet

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A molecule-based two-dimensional ferrimagnet, $[Cr(CN)_6][Mn(S)\text{-pnH}(H_2O)](H_2O)$; ((*S*)-pn = (*S*)-1,2-diaminopropane) is obtained as a green needle-shaped transparent crystal.[1)] Since a chiral (*S*)-pn ligand breaks space inversion symmetry, the complex crystallizes with a chiral space group of Orthorhombic, $P2_12_12_1$ and the Dzyaloshinsky-Moriya interaction would be invoked between spin moments. Thus, there is a greet possibility that the crystal of this complex have a chiral spin structure. However, intensive investigations by neutron diffraction and μSR have attained no explicit evidence of a chiral spin structure. The purpose of this work is to find out magnetic satellite reflections arising from a chiral spin structure.

The SR beam from the undulator at the BL46XU was used with tuning an X-ray energy on 16 keV. The sample crystal was mounted on the cold head of a closed-cycle helium refrigerator. Magnetic satellite reflections are expected to appear on both sides of fundamental reflections with the modulation vector about $0.01\boldsymbol{a}^*$. Despite high resolution of x-rays we encountered difficulties in separating a target signal from a fringing base of fundamental reflections. This expansive overlap of fundamental reflections is found to be caused by splits of a reflection line. In order to clarify crystal lattice's behavior we have measured the temperature dependence of reflection profiles. Figure 1 shows the center position of the 008 reflection lines separated by profile fitting. In cooling process, discontinuous change in a peak position is clearly seen and occurs at the magnetic ordering temperature. In heating process, no discontinuous change is seen and a crystal lattice does not return to its original state above the magnetic ordering temperature. These peculiar behaviors of crystal lattice are supposed to be coupled with complicate spin arrangement through the magneto-elastic effect.

The present result increases the significance of information about a spin structure of the complex. Further investigation is indispensable.

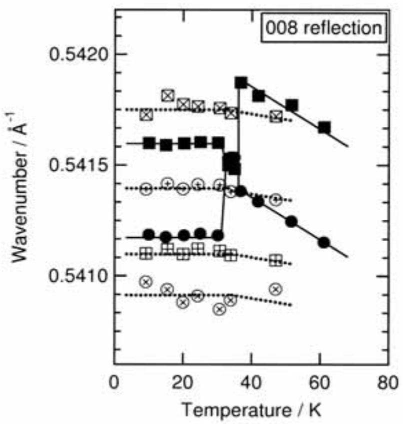

Fig. 1. Temperature dependence of the peak center position. Open and filled symbols represent the 008 reflection lines observed in heating and cooling processes, respectively.

1) K. Inoue, K. Kikuchi, M. Ohba and H. Okawa: Angew. Chem., Int. Ed. **42** (2003) 4810.