

## Mn and Fe K-edges XAFS study of Sn added Mn-Zn ferrite

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### Introduction

Mn-Zn ferrite ((Mn,Zn)Fe<sub>2</sub>O<sub>4</sub>) is used for the transformer materials such as AC adapter of the personal computer, power supply for the backlight of liquid crystal monitor. Recently, there have been strong demands to control composition and impurity of Mn-Zn ferrite strictly, because difference in composition and impurity directly changes their magnetic loss (core loss) characters.

It is known that core loss value is related to the amount of Fe<sup>2+</sup> in Mn-Zn ferrite. On the other hand, we found that a slight amount of Sn in Mn-Zn ferrite caused a drastic change in core loss value. However, how Sn influences the core loss value and which site Sn exists in Mn-Zn ferrite were not yet clarified.

In the present study, we measured Mn K-edge and Fe K-edge XAFS spectra of Mn-Zn ferrite (SnO<sub>2</sub>=0, 0.1, 0.5, 1.0 wt%) and discussed the relation between the amount of Sn and Fe<sup>2+</sup>, and also relation among valence states of Mn and Fe and amount of Sn.

### Experimental

Mn-Zn ferrites (SnO<sub>2</sub>=0, 0.1, 0.5, 1.0wt%) were prepared for XAFS analysis. Major compositions of Mn-Zn ferrites are Fe<sub>2</sub>O<sub>3</sub> (54mol%), MnO (38mol%), ZnO (8mol%). Mn K-edge and Fe K-edge XAFS spectra of these samples were measured in a transmission mode at BL12C, KEK-PF. Powdered samples were diluted with BN and were pressed into disks.

### Results and Discussion

Fig. 1 shows Fe K-edge XANES spectra of Fe-foil, Fe<sub>2</sub>O<sub>3</sub>, Fe<sub>3</sub>O<sub>4</sub> and Mn-Zn ferrites with different amount of Sn. Among four Mn-Zn ferrite sample, no difference was found on Fe K-edge XANES spectra. Compared with the reference compounds, the shoulder of Fe K-edge spectra of Mn-Zn ferrite closely resemble Fe<sub>2</sub>O<sub>3</sub>.

Fig. 2 shows the Fourier transforms of the k<sup>3</sup>-weighted Fe K-edge EXAFS spectra. Among four Mn-Zn ferrite samples, no difference was found in the EXAFS spectra. This result is consistent with that of XANES. These spectra also indicate that Mn-Zn ferrites contain Fe<sup>2+</sup> and Fe<sup>3+</sup> by the peak of 0.19nm related to the Fe-O bonding.

We also measured Mn K-edge XAFS spectra of these Mn-Zn ferrite samples, but both XANES spectra and Fourier transforms of EXAFS spectra showed no difference among these four Mn-Zn ferrite samples. Compared with the reference compounds, it is found that Mn in Mn-Zn ferrite exist in the Mn<sup>2+</sup> state.

From these results, we have found that Sn in Mn-Zn ferrite does not have relation between the Fe and Mn state. It is suggested that the core loss's change in Sn added Mn-Zn ferrite is not caused by change of the amount of Fe<sup>2+</sup> and there may be another factor to effect core loss value.

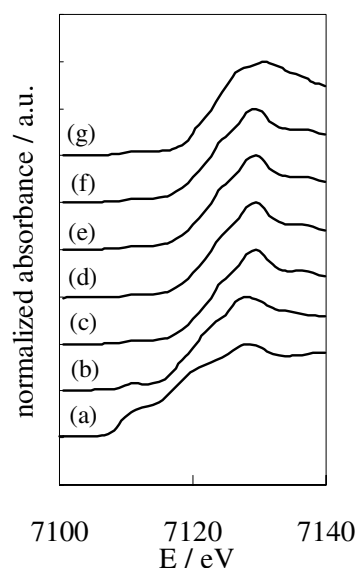


Figure 1. Fe K-edge XANES spectra of (a)Fe-foil, (b)Fe<sub>3</sub>O<sub>4</sub>, (g)Fe<sub>2</sub>O<sub>3</sub>, and (c)-(f)SnO<sub>2</sub> added Mn-Zn ferrites: (c)SnO<sub>2</sub> 0wt%, (d)SnO<sub>2</sub> 0.1wt%, (e)SnO<sub>2</sub> 0.5wt%, (f)SnO<sub>2</sub> 1.0wt%.

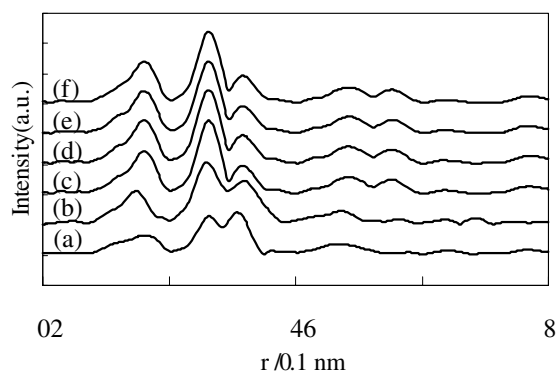


Figure 2. Fourier transforms of the k<sup>3</sup>-weighted EXAFS oscillation of (a)Fe<sub>3</sub>O<sub>4</sub>, (b)Fe<sub>2</sub>O<sub>3</sub> and (c)-(f)SnO<sub>2</sub> added Mn-Zn ferrites: (c)SnO<sub>2</sub> 0wt%, (d)SnO<sub>2</sub> 0.1wt%, (e)SnO<sub>2</sub> 0.5wt%, (f)SnO<sub>2</sub> 1.0wt%