Local structure and Invar effect in Fe-Ni-Cu alloys

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Effect of additional Cu element on the Inver property has been investigated in $(Fe_{65}Ni_{35})_{100-x}Cu_x$ from the structural view points at FONDER. In our previous studies of X-ray diffraction and VSM measurements, clear concentration dependence has been observed in lattice parameter and magnetic transition temperatures T_C and Θ_c, and it is confirmed that Cu is solidly soluble in $Fe_{65}Ni_{35}$ alloy and affects the magnetic properties which has been considered to be closely related to the Inver effect.

At FONDER, three single crystals of $x =$ 0, 2, and 4 have been measured. Figure 1 shows temperature dependance of unit-cell volume and coefficient of volume expansion β for the three alloys. It seems that Cu reduces the Inver effect above $\sim$ 60 K but dose not change the effect below the temperature. Detailed concentration dependance should be studied to clarify this tendency.

Figure 2 shows diffuse intensity map at around (200) and (220) Bragg peaks on $(hk0)$ plane at 10 K in $x = 4$ sample. The lower figures are calculated diffuse intensities with the model of lattice distortion. It has been pointed out that the local lattice distortion originated by fcc-bcc martensitic transformation in Fe-Ni alloy is strongly related to the Invar properties[1]. The observed intensity distributions are somewhat similar to the calculated one, but detail is obscured due to the Debye ring of Al from the radiation shields of CTI (indicated as dashed lines). In order to observe the full distribution of the diffuse intensities, we are now planing to make new shields made by other materials such as carbon.

[1] Y. Tsunoda, *et al.* ;Phys. Rev. **78** (2008) 094105.

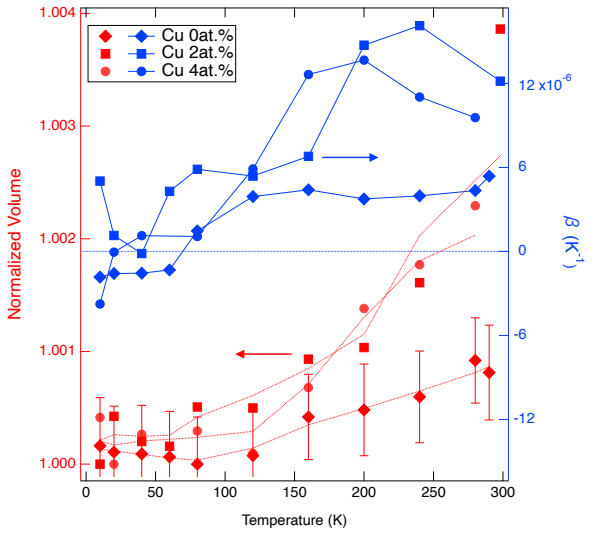

Fig.1: Temperature dependance of volume and coefficient of volume expansion β of $(Fe_{65}Ni_{35})_{100-x}Cu_x$ with $x = 0$, 2, and 4.

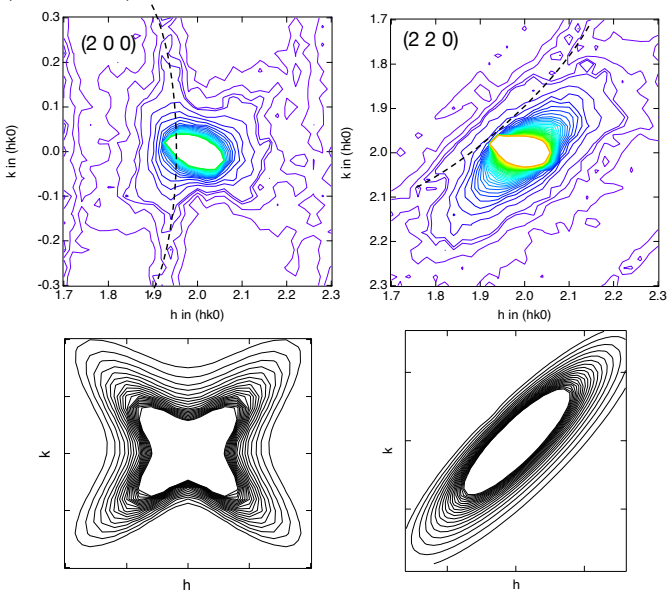

Fig.2: Distribution of diffuse intensities at around (200) and (220) Bragg peaks on $(hk0)$ plane measured at 10 K in $(Fe_{65}Ni_{35})_{96}Cu_4$. In the lower, maps of calculated diffuse intensities originated by lattice distortion are shown.