Electronic states of mechanically alloyed Zr_2Ni

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It is a question of great interest how the electronic states and structure of individual elements change in the process of alloying. The mechanical alloying is a slow diffusion reaction in a solid state. It is convenient to investigating these properties because we can control the reaction by the degree of milling.

In the report we have measured XANES spectra of mechanically alloyed Zr_2Ni near Ni and Zr K edges as a function of milling time. The starting material was the mixture of Zr and Ni powder in the nominal atomic ratio of 2:1. It was milled in a stainless steel vial with stainless steel balls on a vibratory apparatus in an argon atmosphere. The x-ray diffraction shows that the system transform into an amorphous phase by milling for 60 h. There is no change in the x-ray diffraction pattern in the milling from 60 h till 200 h.

The XANES measurement was carried out in the transmission mode at 295 K using a Si(311) monochromator at the BL01B1 station of SPring-8.

XANES spectra near the Ni and Zr K edges of the system are shown in Figs. 1 and 2. The amplitude of oscillation above the edges is reduced with the milling time. This is because the system transforms from the crystalline mixture into the amorphous phase. We pay attention to a shoulder A near both edges shown by the arrow. In the Ni K edge of Fig. 1 the shoulder of 1 h milling is as same as that of pure Ni. But at 20 h it changes the form a little. Milling for 30 h makes it sharp. At 60 h it grows into a peak, which does not change the figure any more after 60 h. In the Zr K edge, on the other hand, pure Zr also has a shoulder A which is as same as that of the specimen of 1 h milling as shown in Fig. 2.. It makes no change till 10 h. After 20 h till 60 h it reduces little by little. The Ni K edge is due to a *1s-4p* electric dipole transition. The prepeak A reflects *3d* states via the *4p-3d* hybridization. The shoulder A of the Zr K edge projects *4d* states via *p-d* mixing. We have observed the same feature of the shoulder A in mechanically alloyed Y_2Ni.[1)]

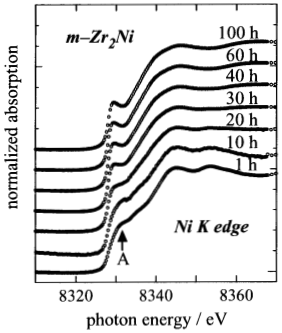

Fig. 1. Normalized absorption of mechanically alloyed Zr_2Ni near the Ni K edge. The figure shows the milling time.

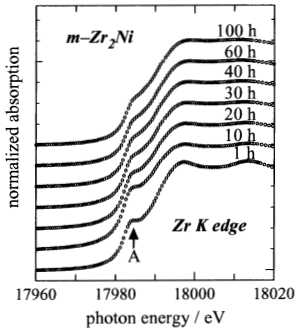

Fig. 2. Normalized absorption of mechanically alloyed Zr_2Ni near the Zr K edge in various milling time.

References

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EXAFS from heat treated Sb-Te alloy film

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EXAFS spectra were measured on the heat treated Sb-Te alloy films. The Sb-Te (Sb75Te25) alloy film is known to change the phase from amorphous to crystalline above 85 ℃. In order to examine premonitory changes in the local structures near the transition temperature, EXAFS spectra were recorded on the sample at the every stage after sequent heat treatment.

Experiments and Results

The Sb-Te sample powder was gathered from flakes of alloy films deposited on a substrate by sputtering. The film is amorphous as deposited. The Sb-Te powder and BN powder were mixed and pressed into a disk. EXAFS spectra were recorded with a transparent mode at the room temperature. Heat treatment of the sample is as follows: after having been held for 10 min. at a fixed temperature stage, the sample was quenched at the room temperature. The sample after EXAFS measurement was heat-treated with the sequent temperature stage.

Figure.1 shows Sb and Te K-edge spectra vs. heat-treatment temperature. The spectra shows that local structure change occurs at the Sb and Te sites above the transition temperature, and no premonitary change was observed.