High resorution inelastic neutron scattering by TiNi(Fe) alloy

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TiNi alloy system exhibits martensitic transformation, which shows typical first-order transformation. A few percent Fe added and substituted by Ni alloys were utilized for fundamental studies of martensitic transformation about 20 years ago. R-phase was found through the research and was thought at the beginning to be a precursor state of martensite. Later the R-phase was understood to be another type of martensite, whose structure was determined by Hara et al. Recently, systematic studies of Fe added alloys more than 2 percent were carried out. Calorimetric measurements and electrical resistivity measurements indicated different transformation behavior from first-order transformation for six or eight atomic percent alloys; that is Ti50Ni44Fe6 or Ti50Ni42Fe8. Calorimetric measurements show no transformation peak for those alloys. Electron diffraction studies and X-ray diffraction studies were also carried out for those alloys. Crystal structure of high temperature phase is B2 (CsCl) type. Diffuse peaks appeared around 1/3 of <110>* with lowering temperature. Those electron diffraction patterns were similar to diffraction patterns of R-phase. Since the martensitic transformation is known to be displacive transformation, phonon behavior is attractive mechanism for understanding the transformation. From the structural knowledge, [zz0]TA2 mode was expected to be soft at the transformation temperature. Ohba et al. measured phonon behavior for TiNi system previously. However no clear phonon softening was observed. Inelastic scattering measurements for larger than z=0.3, which is most important part of the phonon, showed disturbed peaks. Therefore, precise and high-resolution experiments were required. Inelastic scattering measurements for [zz0]TA2 mode were carried out at various temperatures. Figure 1 showed neutron inelastic experimental data for the alloy measured at 180K. Electron diffraction patterns at the temperature indicated R-phase like pattern. Incoherent intensities were subtracted from the observed data and shown in the figure, simultaneously. Inelastic phonon peak was found close to E=0, which may indicate almost complete softening of martensitic materials.

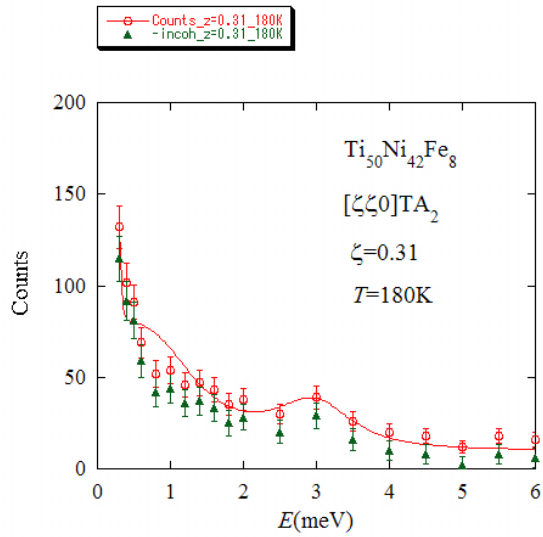

Fig. 1. Inelastic scattering data for [zz0]TA mode at 180K. The row data and incoherent intensities subtracted data were plotted.