Comparison between TEY and FY Methods in Ni and Mn 2p XAS

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Transition metal (TM) elements play central roles in various technologically important materials, from intermetallic compounds to oxides. TM 3d electronic states play important roles in controlling the physical properties of these materials. TM 2p core-level photoabsorption spectroscopy (TM 2p XAS) has been one of the useful tools in the investigation of the TM 3d electronic states because the electric dipole transition from TM 2p state to the 3d state is the main origin of the TM 2p photoabsorption.

Several methods have been used in XAS measurement. Here, we focus on the differece between total electron yield (TEY) and fluorescence yield (FY) methods. We have studied a Ni-Mn based intermetallic compound by TM 2p XAS in TEY and FY modes. Experiments have been performed at BL11 of SR Center, Ritsumeikan University. The FY detector was set on the same horizontal plane as the SR in the angle of 45° from the SR beam.

Figure 1 (2) shows the measured Mn (Ni) 2p XAS in TEY and FY modes. There are several differences between the two modes and the degree of difference is not the same between Mn and Ni.

First, we focus on the difference in the intensity ratio between the L_3 ($2p_{3/2}$) and L_2 ($2p_{1/2}$) edges. In Mn 2p XAS, the intensity of L_2 relative to L_3 was much smaller in TEY than in FY. On the other hand, the intensity ratio was nearly the same between TEY and FY in the case of Ni 2p XAS. This tendency reproduces the tendency found in theoretical calculations, where L_2 is stronger in FY, especially in the depolarized geometry [1].

In Ni 2p XAS, lineshape was not very much different between TEY and FY. However in Mn 2p XAS, lineshape drastically changed between the two methods. In the L_3 region, the peak-top region of the TEY mode seems to be very much suppressed in the FY, possibly because of the self-absorption effect. In the L_2 region, the difference is not that the strong peak is suppressed but the relative intensity ratio of the multiplet structures is different. This kind of difference may be reflecting the difference of surface and bulk electronic states. However, consistent explanation of the small difference in Ni 2p XAS and the large difference in Mn 2p XAS has to be further discussed.

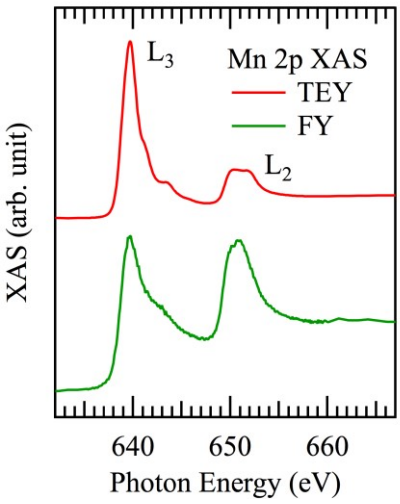

Fig. 1 Mn 2p XAS of a Ni-Mn based alloy measured by TEY and FY methods. Strong measurement method dependence is seen in the spectral shape.

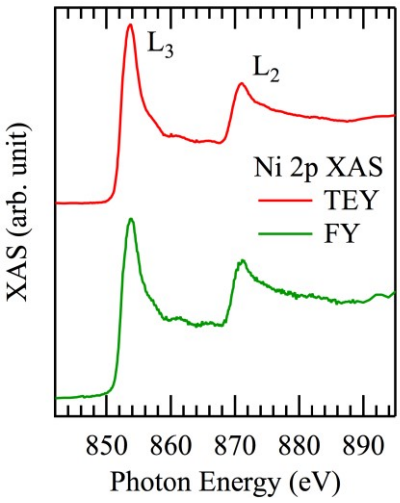

Fig. 2 Ni 2p XAS of a Ni-Mn based alloy. Measurement method dependence is smaller.

Reference

[1] R. Kurian *et al.*, J. Phys.: Condens. Matter **24**, 452201 (2012).