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Size dependence of Pd magnetic moment in PdFe fine particles

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Introduction

In the fine particle system, the magnetic properties are severely affected by the surface effects and are different from that of bulk. Previously, we found that the saturation magnetization of PdFe fine particles was decreased with decreasing the particle size. This decrease can be explained in terms of the non-magnetic surface layer [1]. The nonmagnetic surface layer was thought to originate in the change in the electronic structure of the host Pd at the particle surface. In this work, to investigate the magnetic nature of the host Pd in the PdFe fine particles, we performed the X-ray magnetic dichroism (XMCD) measurements of PdFe fine particles at the energy of Pd $L_{2,3}$ edges.

Experimental Procedures

PdFe (2.9 at. % Fe) fine particle sample was prepared by conventional gas evaporation method under an Ar gas atmosphere, and they were packed in a sample case made by polyimide film under a He atmosphere. The XMCD measurements were performed at the at the beam line BL-28B in the Photon Factory (KEK-PF), using the fluorescent mode at the temperature of 20 K and applied field of 6 kOe parallel to the sample plane. The energies of incident beam are around Pd $L_{2,3}$ edges.

Results and Discussion

The XAS and XMCD data was corrected considering the self-absorption effect and the absorption in the beam path [2]. The corrected XMCD spectra were shown in Figure 1. From these results, we estimated the spin and orbital magnetic moments of Pd using magneto-optical sum rule. The spin and total magnetic moments were smaller than that of bulk, and the orbital magnetic moments were almost zero. Figure 2 shows the size dependence of Pd magnetic moments in PdFe fine particles. This indicates that the Pd moment is constant against the change in the size, which disagrees with the results of magnetization measurements. Therefore, the decrease in the magnetization of PdFe fine particles may be due to the decrease in the Fe moments.

On the other hand, to see the XMCD spectrum at Pd L_2 edge in more detail, there is a satellite (or a shoulder) at the high energy side of main feature. As this satellite peak at the distance of ~ 4 eV from the main peak can be attributed to the character of $4d^8$ configuration [3], the result that the satellite peak becomes more intensive as decreasing particle size, reflects the change in the electronic structure of *d*-band at surface of PdFe fine particles.

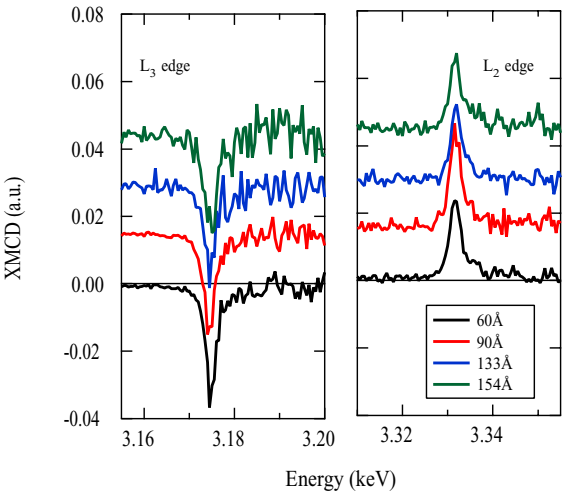

Figure 1 XMCD spectra of PdFe fine particles, measured at Pd $L_{2,3}$ edges.

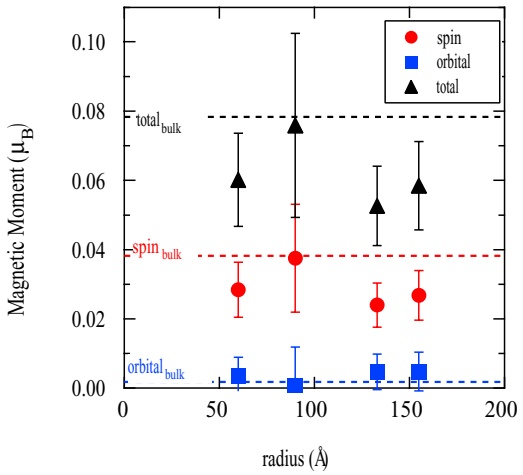

Fig.2 Size dependence of Pd moments in PdFe

References

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