

Resonant and Non-Resonant Scattering Observed in the Forbidden Reflections of Hematite(Fe_2O_3) and Eskolait(Cr_2O_3)

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Both hematite and eskolait have corundum structure and are antiferromagnetic at room temperature. The direction of magnetic moment is nearly in the c-planes. In hematite, the moment of adjoin planes are oposit direction but the moment of a c-plene is zero in eskolait. Therefore, X-ray magnetic secattering of $00l$ reflections can be observed in hematite [1] but not in eskolait. Near the Fe K-absorption edge, Finkelstein et al. measured resonant scattering of the "forbidden" 003 reflection in hematete and observed that the azimuthal angle dependence of the intensity was six-fold symmetry.[2] We measured the resonant scattering of the "forbidden" 003 and 009 reflections near the Fe (Cr) K-edge in hematete (eskolait).[3] In hematite the energy spectrum shows non-resonant intensity as well as resonant one. But, there is only resonant scattering in eskolait. Azimuth dependence of the resonant 003 reflection in hematite shows three-fold symmetry but in eskolait, six-fold one. The six-fold symmetry agrees with the calculation based on quadrupole transition. The three-fold symmetry can be explained by interference between dipole-quadrupole and quadrupole scattering. For non-resonant intensity in hematite, the azimuth dependence shows two-fold symmetry. Below the Morin temperature ($T_M=250\text{K}$), the direction of magnetic moment changes parallel to the c-axis. The observed non-resonant intensity disappeared below the T_M . The temperature dependence is consistent with that of neutron measurements for the 003 reflection. Therefore, the non-resonant intensity is due to magnetic scattering caused by the antiferromagnetic structure. For the 009 reflection, azimuthal dependence in hematite shows rather complicated behavior, neither three-fold nor six-fold symmetry as shown in Fig. 1 (a). But in eskolait, it shows six-fold symmetry. Azimuth dependence of the 009 in hematite becomes three-fold symmetry below the Morin temperature as shown in Fig. 1 (b). This means some contributions of magnetic effect to the electric resonant scattering.

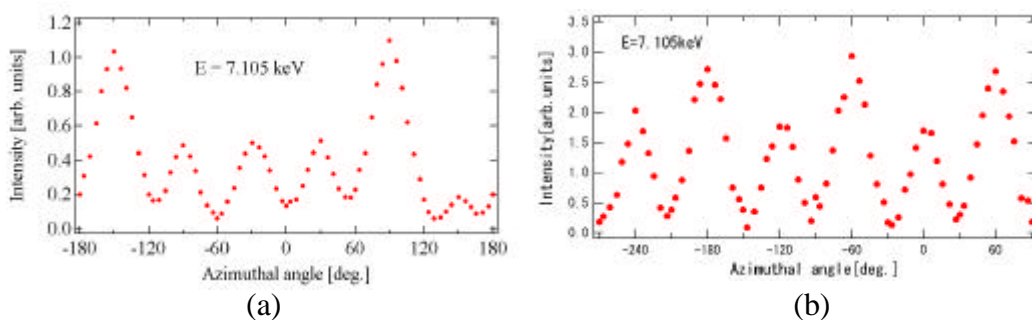


Figure 1: Azimuth dependence of the 009 resonant reflection in hematite observed at (a) room temperature and (b) 150 K

References

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