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Resonant x-ray scattering study of EA_2CuCl_4 under high pressure

Kenji Ohwada[1], Kenji Ishii[1], Tosyiya Inami[1], Youichi Murakami[2]
[1]Japan Atomic Energy Research Institute, 1-1-1 Koto, Mikazuki, Sayo, Hyogo 679-5148, Japan
[2]Department of Physics, Tohoku University, Sendai, Miyagi, 980-8578, Japan

Introduction

Layer compound $(C_2H_5NH_3)_2CuCl_4$ (EA_2CuCl_4) has an antiferro-distortive (AFD; Jahn-Teller (JT) distortion) arrangement in *ab*-plane (intra-layer) where the Cu^{2+} ($3d^9$) 3d-holes order as $-d_{x2-z2}-d_{y2-z2}-d_{x2-z2}-d_{y2-z2}$----. This arrangement makes this system ferromagnetic (FM) in the intra-layers, whereas the inter-layer interaction is anti-ferromagnetic (AFM). Raman scattering study under high pressure observed the disappearance of the intensity of ν(Cu-Cl) mode around 4 GPa showing the suppression of the JT distortion[1]. Though it is anticipated above 4 GPa that a new hole order and a corresponding new magnetic interaction appear, such a phenomena is not observed yet.

Experimental

To clarify these problems, we planned to study the JT suppression under high pressure. We performed resonant x-ray scattering (RXS) experiment under high pressure at BL-4C. Resonant signal come from the JTD has been clearly observed at ambient pressure. Pressure was generated in a DAC using 1:1 mixture of n-pentane:i-pentane pressure transmitting media which guarantees the hydrostaticity up to 6 GPa.

Results and Discussion

Figure 1 shows the pressure dependence of 020 peak profiles below and above the transition pressure P_c = 4 GPa. Peak split along the *c*-axis, which is a direct evidence of the phase transition, has been clearly observed. We then measured the pressure dependence of the intensity at resonant peak 010 (*E*i = 8.98 keV) as shown in Fig. 2. The observed intensity locates in the hatched area and shows no drastic reduction as the pressure increases as expected from the Rietveld analysis under high pressure[2]. We have no idea, why the intensity shows no large reduction below *P*c, however, the intensity wiped out above *P*c within present detection limit > 10^{-3}.

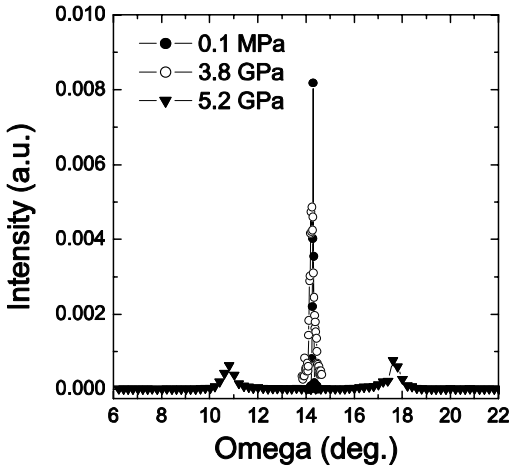

Fig. 1: 020 peak profiles before and after the phase transition 4 GPa. Peak split takes place along the *c*-axis.

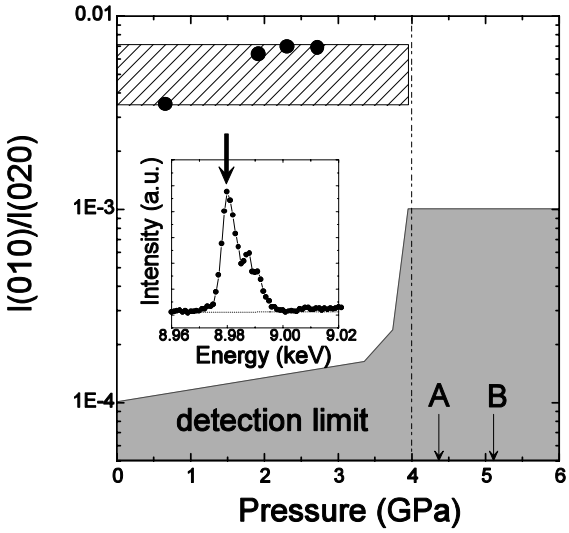

Fig. 2: Pressure dependence of the normalized peak intensity 010/020. Gray region means the detection limit. The intensity wiped out above *P*c confirmed at 4.4(A) and 5.1(B) GPa.

References

[1] Y. Moritomo *et al.* J. Chem. Phys. **101**(3) (1994) 1763.
[2] K. Ohwada *et al.* SPring-8 User Experiment Report (2002B).