Layer compound \((\text{C}_2\text{H}_5\text{NH}_3)_2\text{CuCl}_4\) (EA\(_2\)CuCl\(_4\)) 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 \(-d_{x^2-y^2}-d_{z^2}-d_{x^2-y^2}-d_{z^2}-\cdots\). 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 \(\nu(\text{Cu-Cl})\) 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.

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.

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 \((E_i = 8.98\text{ keV})\) 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\(^{-3}\).

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{fig1}
\caption{020 peak profiles before and after the phase transition 4 GPa. Peak split takes place along the \(c\)-axis.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{fig2}
\caption{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.}
\end{figure}

References