1. Introduction

Filled skutterudite compounds RT_4X_{12} (R: rare earth, T: transition metal, X: pnictogen) have a unique crystal structure in which R ions are located inside the cage formed by twelve X ions and exhibit various physical properties depending on the combination of the constituent elements. Among them, $EuFe_4As_{12}$ shows the highest magnetic ordering temperature of Tc=152K. In a previous time-of-flight (TOF) powder neutron diffraction experiment on $EuFe_4$As12 at BL20 in J-PARC/MLF, magnetic Bragg peaks were observed below Tc, but it was difficult to estimate the effect of absorption by Eu, a high-neutron-absorbing element, especially for Bragg peaks with long periods. Therefore, we reanalyzed the neutron diffraction data of this compound by dividing the data in the low-angle detector bank and taking into account the effect of absorption at each detector position, considering the effect of the time-focusing method in TOF powder neutron diffraction experiments on the absorption correction, and estimated the effect of absorption for Bragg peaks with long periods, where the information on the crystal structure was used in the estimation. However, since the incident neutron energy corresponding to the Bragg peak with the longest period is about 40 meV and the effect of absorption is very large, it was necessary to confirm the validity of this absorption correction over other different correction methods.

2. Experiment

The powder sample of $EuFe_4As_{12}$ was set in a flat Al sample cell with a sample space thickness of 0.2 mm. Powder neutron diffraction measurements were carried out with and without a 2 mm thick vanadium plate placed downstream of the incident neutron beam in the sample cell. Empty cells with and without the vanadium plate were also measured. The d-dependence of the incoherent scattering intensity of vanadium measured in the low-angle detector bank was used to estimate the effect of absorption, including the effect of the time-focusing method on the absorption correction.

3. Results

Figure 1 shows the d-dependence of the scattering intensity with vanadium plates minus the scattering intensity without vanadium plates (red: powder sample, blue: empty cell). Figure 2 shows the difference between the data for the powder sample minus the data for the empty cell in Fig. 1. From this result, we can estimate the practical effect of absorption, including the effect of the time-focusing method on the absorption correction. The results show that the effect of absorption is strong in the long d region, i.e. in the low incident neutron energy region. The effect of absorption estimated from the incoherent scattering intensity of vanadium is in close agreement with that estimated from the transmission coefficients studied so far.

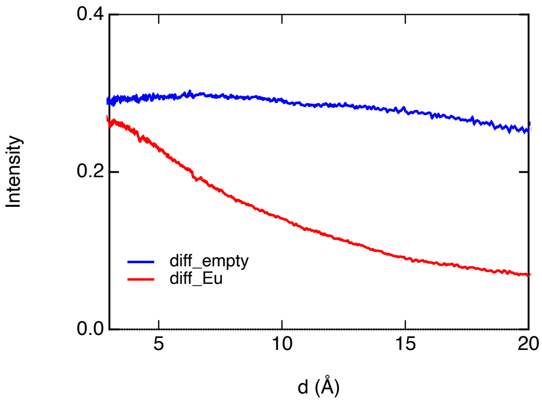

Figure 1

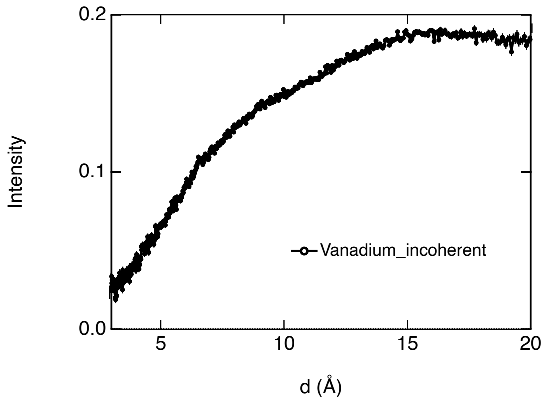

Figure 2

4. Conclusion

The effect of absorption in the diffraction peaks in the low-energy region, evaluated by incoherent scattering of vanadium, was found to approximately reproduce the effect of neutron absorption estimated from the data at each detector position by using information on the crystal structure of $EuFe_4As_{12}$ and by dividing the data in the low-angle detector bank. This experiment confirmed the validity of the estimated transmission coefficients that have been studied so far. The analysis using the transmission coefficients clearly shows that the ordered state below Tc in EuFe4As12 is not a simple ferromagnetic state. The estimate of the transmission coefficient from incoherent scattering of vanadium used in this study may be useful to correct for the absorption of diffraction peaks in the low-energy region, where the effect of absorption is significant.