

Concurrent Measurements of Neutron Diffraction and AC Susceptibility in the Pressure-Induced Superconducting Ferromagnet UGe₂

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Saxena *et al.* discovered the ferromagnetic (FM) superconductor UGe₂ in which superconductivity (SC) occurs at high pressure range between ~ 1.0 and ~ 1.5 GPa. [1]. In the FM phase, there seems to be another phase transition or crossover at T_x ($\simeq 32$ K at ambient pressure). This characteristic temperature T_x also decreases with increasing P and becomes suppressed to zero at a critical pressure P_x ($\simeq 1.2$ GPa) where a maximum SC transition temperature ($T_{SC} \sim 0.7$ K) appears. In our previous work [2], we presented the temperature dependence of magnetic Bragg peak intensities under P by the neutron diffraction (ND) technique to reveal the nature of the transition at P_x . We have found that the low- T behavior of the uniform magnetization can be explained by a conventional Stoner model, indicating that the FM state below P_x can be understood as the perfectly polarized state.

Very recently, Ban *et al.* reinvestigated a SC phase diagram of UGe₂ by AC magnetic susceptibility measurements. [3] They found that the T_{SC} and volume fraction show a "M-shaped" structure as a function of P and suggested that both of two critical points play an important role in the occurrence of SC. These observations are possibly ascribed to the improved homogeneity of the P transmitting medium. To examine the correlation between SC and FM in UGe₂, we have to perform ND measurements by simultaneously detecting the superconductivity in UGe₂.

A single crystal was grown by Czochralsky pulling method with a tetra-arc furnace. The P was generated by a beryllium-copper pressure cell [4] using Daphne oil 7373 as a P transmitting medium, instead of Fluorinert FC-75 used in the previous measurements. [2, 4] Coils of ac susceptibil-

ity measurements are wound in the outside of the cylinder. The P was estimated by determining the T_{SC} of Sn. Elastic ND experiments has been performed on the triple-axis spectrometer PONTA (5G) at temperature down to 0.1 K using a dilution refrigerator.

In this study, the pressure was tuned just above P_x , where no FM Bragg peak jump was observe corresponding to T_x . AC susceptibility measurements successfully show the 80 % volume fraction of SC at 0.2 K with T_{SC} of 0.58 K in UGe₂. As shown in fig. 1, there seems little change in the FM bragg peak profiles between at 0.2 K (below T_{SC}) and 1 K (above T_{SC}).

References

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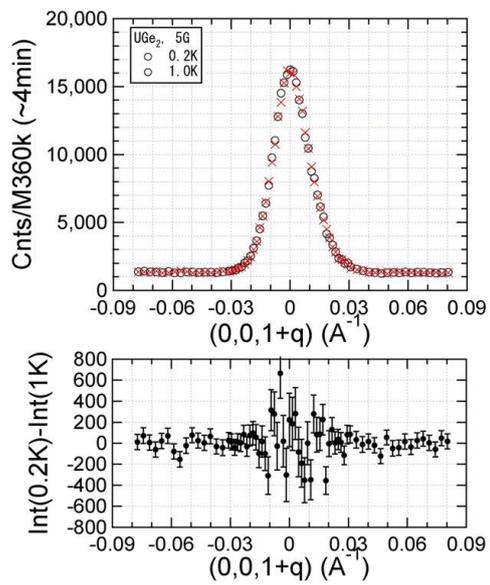


Fig. 1. FM Bragg peak profiles of through (a) $Q = (0, 0, 1)$ (upper) and (b) its temperature difference between 0.2 K and 1 K (lower).