

Correlation between ferromagnetism and superconductivity in 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 deuteride methanol and ethanol mixture as a P transmitting medium. [2, 4] Coils of ac susceptibility measurements are wound in the out-

side of the cylinder as shown in fig. 1. 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, although the pressure was tuned just at P_x , unfortunately only 20 % volume fraction of SC at 0.1 K were seen with $T_{SC} \sim 0.4$ K in UGe₂. Furthermore we have to tilt the dilution fridge by ~ 4 degrees and then the outer coil may touch the radiation shield of the fridge. Thus we are now analyzing the obtained neutron data.

References

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Fig. 1. Pressure cell together with the AC susceptibility coil.