Anisotropy of the Upper Critical Fields of Sr_2VO_3FeAs Single Crystal

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Introduction

Among various Fe pnictide superconductors, Sr_2VO_3FeAs (T_c ~ 30 K) has several distinct characteristics from other Fe pnictides. It consists of alternate stacking of the "SrFeAs"-type pnictide layers and "$SrVO_3$"-type V oxide layers, and the insertion of the V oxide layer in between the FeAs layers is expected to strongly affect the superconducting properties. Recent LDA calculations predicted that the $SrVO_3$ layer is metallic due to partial occupation of the V 3d bands at the Fermi level, while LDA+U calculations suggested that $SrVO_3$ layer is Mott-insulating due to strong correlation in V 3d states. The essential question for understanding superconductivity of Sr_2VO_3FeAs is what the ground state of $SrVO_3$ layers is. In order to clarify the character of the $SrVO_3$ layer, it is highly desirable to investigate the anisotropy in the physical properties of single crystals of Sr_2VO_3FeAs.

Experimental

The high-quality single crystals of $SrMnBi_2$ are used for the magnetotransport measurements in a conventional 6-probe configuration under high magnetic fields in a resistive magnet (33 T, 1.5 K). Single crystals of Sr_2VO_3FeAs were grown by flux melting methods.

Results and Discussion

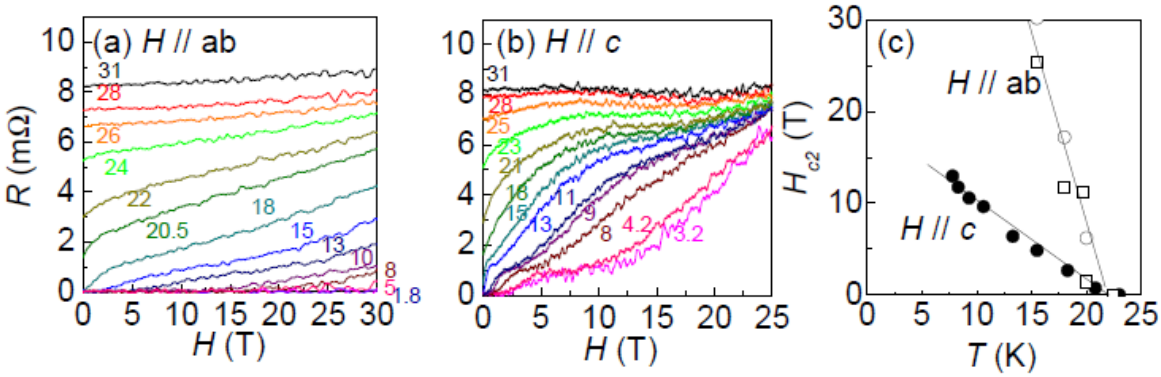

Figure 1. Magnetic field dependence of the in-plane resistance for Sr_2VO_3FeAs at various temperatures with (a) *H*//*ab* up to 30 T and (b) *H*//*c* up to 25 T. (c) Temperature dependence of H_{c2} for different field directions, *H*//*ab* and *H*//*c*.

Figure 1 (a) and (b) show the magnetic field dependence of the resistivity of the Sr_2VO_3FeAs single crystal with different magnetic field orientations, *H//ab* and *H//c*. For *H//ab*, the resistive transition occurs relatively higher magnetic fields. In contrast, with *H//c*, the superconducting state is rapidly destroyed by the magnetic fields and the resistive transition becomes broadened. These contrasting behaviors in fact manifest the strong anisotropy in the superconducting properties. The anisotropy determined by the ratio between H_{c2}(*H*//*ab*) and H_{c2}(*H*//*c*) is ~ 6 as shown in Figure 1(c), that is comparable with the so-called 1111 type iron pnictides, where the insulating rare earth oxides are inserted in between the FeAs layers. These findings confirms that the inserted $SrVO_3$ layer is indeed insulating, which implies that Sr_2VO_3FeAs is a rare example of Fe-pnictides containing both superconducting FeAs layers and Mott-insulating oxide layers.

Conclusions

Based on magnetotransport properties of Sr_2VO_3FeAs single crystal under high magnetic fields with different orientation, we found a strong anisotropy in the upper critical fields. This provides an indirect evidence of Mott-insulating nature of the $SrVO_3$ layer in Sr_2VO_3FeAs.

Acknowledgements

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References

[1] Man Jin Eom, *et al.*, *to be submitted.*