Mapping Out the Phase Diagram for Superconductivity on $Ir_{(1-x)}Pt_xTe_2$

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Introduction

$IrTe_2$ is a member of the transition metal chalcogenides, which has been a hot topic due to the charge density wave (CDW) transition [1], which occurs at the temperature $T_s \approx 250$ K and can be observed in the transport measurement as an increase in resistivity, also in x-ray studies as a structural distortion [2]. It is also known that a small amount of Pt or Pd doping (x) induces superconductivity (SC) with transition temperature, $T_{SC} < 4$ K [1, 3]. It has been shown that T_{SC} increases by increasing x, until a critical value of x is reached. However the superconductivity in $IrTe_2$ with $T_{SC} \approx 2$ K is only recently reported by Fang *et al* [4] and they reported only filamentary superconductivity, not bulk. Therefore, more study is required to confirm the existence of SC transition in this compound.

Experimental

The transport properties of the samples were measured using a standard four-probe technique with SR830 lock-in amplifier. The experiment was carried out in the SCM1 millikelvin facility at NHMFL. Due to the small voltage signal, SR554 preamplifier was used with 500x amplification.

Results and Discussion

The transport measurement shows a sign of superconducting transition in $IrTe_2$, as reported by Fang *et al* [4]. The SC transition temperature is lower than reported, $T_{SC} \approx 1.6$ K in our case, whereas the reported value is around 2 K. However, in the present case, there is a second transition that occurs at T ≈ 0.25 K, which is sharper than the former transition, hence more closely resembles a bulk transition. Therefore, it is possible that the $IrTe_2$ indeed exhibits superconductivity. On the other hand, pure elemental iridium becomes superconducting at $T = 0.16$ K [5], so there is also a possibility of excess iridium on the surface above the percolation threshold and so elemental analysis is required.

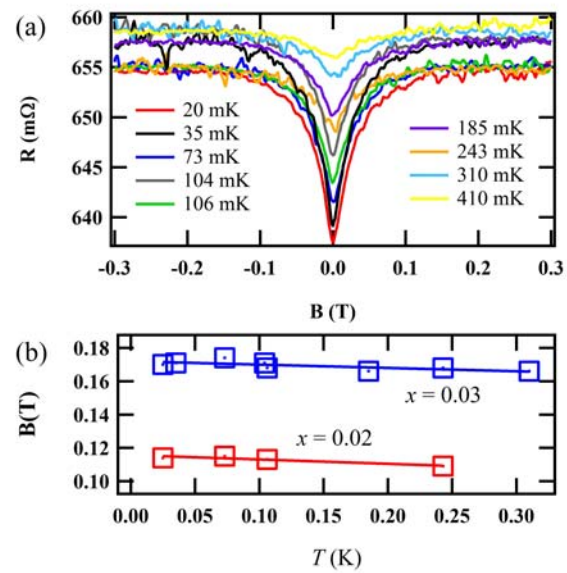

Figure 1 (a) The field dependence of resistance of $IrTe_2$, (b) The temperature dependence of the critical field for $x = 0.02$ and 0.03.

Conclusions

We have performed a transport measurement on $IrTe_2$ compound. The result shows a possibility of the existence of superconductivity in $IrTe_2$. However, the result from the transport measurement alone is inconclusive and has to be supplemented by magnetization and specific heat measurements in order to prove the existence of the SC transition. EDS may have to be performed to probe excess iridium that may lead to the lower temperature SC transition.

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References

[1] Pyon, S., *et al*, J. Phys. Soc. Jpn. **81**, 053701 (2012).
[2] Yang, J. J., *et al*, Phys. Rev. Lett. **108**, 116402 (2012).
[3] Matsumoto, N. *et al*, J. Low. Temp. Phys. **117**, 1129 (1999)
[4] Fang, A. F. *et al*, Sci. Rep **3**, 1153 (2013)
[5] Hein, R. A. *et al*, Phys. Rev. Lett, **8**, 408 (1962)