Competition Between the Structural Phase Transition and Superconductivity in $Ir_{(1-x)}PtxTe_2$, As Revealed by High Pressure Measurements

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Introduction

$IrTe_2$ belongs to the family of the transition metal chalcogenides, which has attracted considerable attention due to the existence of a transition at $T_s \approx 250$ K, which appears in the transport measurement and has been described as due to charge density wave (CDW) transition [1]. It has been reported that a small Pt or Pd doping (x) induces superconductivity (SC) with $T_{SC} < 4$ K [1, 2]. Furthermore, with increasing x, T_{SC} increases until the critical doping value is reached [1, 2]. However, the chemical pressure effect induced by the doping is anisotropic, in which the lattice parameters contract on the *a*-*b* plane, while expand along the *c*-axis. Pressure study is desirable as a first step in determining whether the geometry or volume is the primary cause for the transitions.

Experimental

The transport measurement was performed by using a standard four-probe technique. The high-pressure transport measurement was done using a piston cylinder pressure clamp cell with Daphne oil 7373 as the pressure medium. Single crystal neutron diffraction studies were carried out at the HB-3A four-circle diffractometer at the High Flux Isotope Reactor, Oak Ridge National Laboratory.

Results and Discussion

The transport measurements on the polycrystalline compound with $x = 0.03$ show an increase in the resistivity at T_s and SC transition at $T_{SC} < 3$ K. With increasing pressure T_s increases, while T_{SC} decreases. Their values at different x and pressure are summarized in **Figure 1(b)**.

Neutron diffraction studies on the as-prepared parent compound shows a volume contraction of 0.9% below T_s. This volume contraction is consistent with the scenario of structural transition from trigonal at $T>T_s$ to monoclinic at $T<T_s$ by establishing a shorter Ir-Ir bond along the *b*-axis [2, 3]. Therefore, the pressure stabilizes the low temperature, low volume, monoclinic phase which resulting in the increase in T_s.

It is clear that increasing doping and increasing pressure affect the sample in the opposite way. However, both show essentially the same effect: SC transition is suppressed by the stabilization of the low temperature, low volume phase. Therefore, the competition between SC and the structural transition is clearly demonstrated in $Ir_{(1-x)}Pt_xTe_2$.

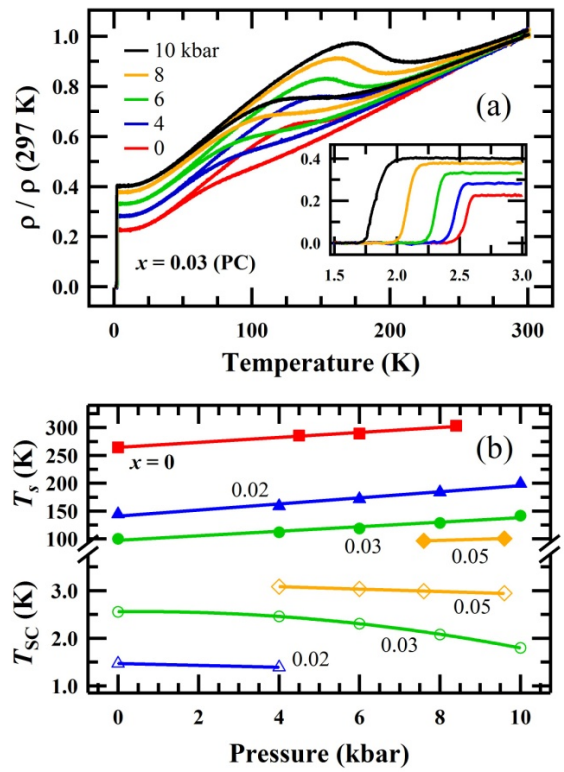

Figure 1. (a) The Temperature dependence of the resistivity for $x = 0.03$, the inset shows the SC transition, (b) The phase diagram of $Ir_{(1-x)}Pt_xTe_2$

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