GROWTH OF HIGH QUALITY Sr_2RuO_4 AND $Sr_3Ru_2O_7$ SINGLE CRYSTALS

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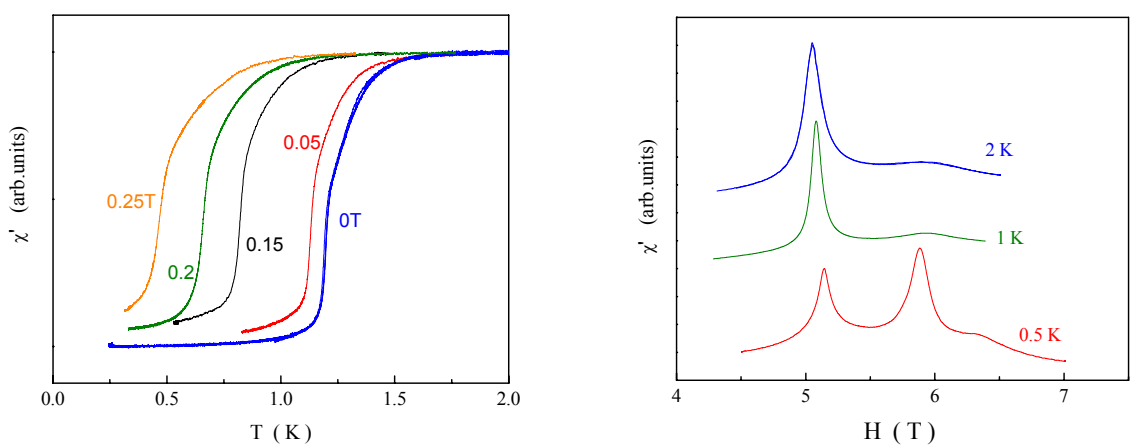
Introduction

Ruddlesden-Popper ruthenate family $Sr_{n+1}Ru_nO_{3n+1}$ attracts considerable attention due to a rich variety of ground states. For instance, single layered Sr_2RuO_4 exhibit unconventional spin-triplet superconductivity while bilayered $Sr_3Ru_2O_7$ is an itinerant metamagnet that is close to quantum critical point. Due to strong volatilization of RuO_2 [1] only a few experimental groups are able to produce high quality ruthenates. The goal of this work was to grow large high quality Sr_2RuO_4 and $Sr_3Ru_2O_7$ single crystals.

Growth process and characterization of the material

As starting materials for the feed rods RuO_2 and $Sr(CO)_3$ were used. These powders were mixed with 10-15% excess of the RuO_2 compare to the molar ratio. Sr_2RuO_4 and $Sr_3Ru_2O_7$ feed rods were synthesized in a furnace at T=1420°C during 24h in the CO_2 or O_2 flow, respectively. The floating zone growth of Sr_2RuO_4 and $Sr_3Ru_2O_7$ also was carried out in CO_2 or O_2 atmosphere at the rate 30mm/h using URN-2-ZM installation [2]. Strong evaporation of RuO_2 observed during the growth process was compensated by the excess of the RuO_2 mentioned above. On final step samples were annealed in O_2 during 100h at T=1000°C. Resulting single crystals were up to 30 mm in length and 4 mm in diameter. The block disorientation of the crystals did not exceed 0.5-1.0^o according to the back-Laue data. Low temperature (0.25 – 4.2 K) AC susceptibility measurements on Sr_2RuO_4 (Fig. 1 (a)) and $Sr_3Ru_2O_7$ (Fig. 1 (b)) single crystals were used for characterization of the material quality. These measurements were carried out in 18 T SC magnet. The rather high zero field superconducting transition temperature of 1.25 K confirms a good quality of the Sr_2RuO_4 single crystals. Double metamagnetic transition observed in $Sr_3Ru_2O_7$ at 0.5 K is in a good agreement with literature data [3] and proves the high quality of these crystals also.



(a) (b)

Fig 1. The real part of the AC susceptibility as a function of temperature at various magnetic fields for Sr_2RuO_4 (a); and magnetic field dependence at three temperatures for $Sr_3Ru_2O_7$ (b). In both cases H is perpendicular to the *c*-axis.

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References

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