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Magnetoresistance of filled skutterudite compound $TbRu_4P_{12}$

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New filled skutterudite compound $TbRu_4P_{12}$ has been synthesized under high pressure [1]. Thermal variation of magnetic susceptibility suggests the existence of two successive antiferromagnetic phase transitions (T_N=20K and T_1=10K). Two-step metamagnetic transition is observed below T_1. Furthermore, a rapid increase of resistivity is observed below T_N. This may be due to nesting of the Fermi surface. Similar behavior is observed in $PrFe_4P_{12}$. Recently, the specific heat of $TbRu_4P_{12}$ in magnetic fields has been reported. The specific heat at zero field shows two peaks around T_N and T_1. The anomaly around T_1 is rapidly suppressed above 1T. On the other hand, the peak at T_N gradually shifts to lower temperature side as field increases and is still observed at 8T. Furthermore, new anomaly is observed above 2T below T_N. These results suggest $TbRu_4P_{12}$ has a complicated magnetic phase diagram including at least four magnetic phases.

Electrical resistance measurements in magnetic fields have been performed on filled skutterudite $TbRu_4P_{12}$ in order to investigate in detail the magnetic phase diagram. Figure 1 shows the temperature dependence of the resistance R(T) of $TbRu_4P_{12}$ at various magnetic fields. The rapid increase at T_N is gradually suppressed and T_N slightly shifts to lower temperature side as field increases and is still observed at 6T. The result is consistent with the specific heat data. We discuss about the magnetic phase diagram of this system in detail.

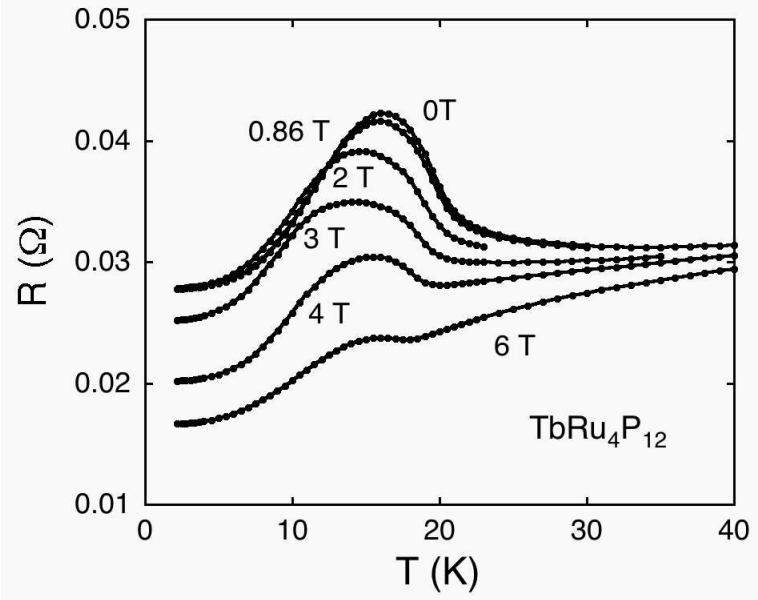

Figure 1: Temperature dependence of the resistance of $TbRu_4P_{12}$ at various magnetic fields.

[1] C. Sekine et al., Phys. Rev. B 62 (2000) 11581.