

Pressure-induced superconductivity in PrRu₄P₁₂

A. Miyake¹, K. Shimizu¹, C. Sekine², K. Kihou², I. Shirotnani²

1 - Research Center for Materials Science at Extreme Conditions, Osaka University,
Toyonaka, Osaka 560-8531, Japan

2 - Faculty of Engineering, Muroran Institute of Technology,
Mizumoto, Muroran 050-8585, Japan

The metal to insulator transition was observed at $T_{MI}=62$ K in filled skutterudite PrRu₄P₁₂ [1]. The semiconductor-like resistivity below T_{MI} was reported to be suppressed with pressure up to 8 GPa [2]. We expect that the insulator phase may change to metallic phase at higher pressure, and have measured electrical resistivity at low temperature and under high pressure up to 15 GPa in PrRu₄P₁₂. With increasing pressure, the semiconductor-like resistivity was suppressed. We observed metallic behavior in the resistivity above 11 GPa and below 50 K, while the anomaly was observed at around 60 K. Above 12 GPa a drop in the resistivity was observed at around 2 K. The temperature dependence of the resistance at 14.7 GPa is shown in Fig. 1. With applied the magnetic field, the drop shifted to lower temperature, and disappeared above 2 T as shown in the inset of Fig. 1. This suggests that the drop is the appearance of the superconductivity. This is the first example of pressure-induced superconductor in filled skutterudite compounds. Some anomalies in the resistance at around $T_{MI}=60$ K, $T_{A1}=50$ K, $T_{A2}=20$ K and $T_c=2$ K were observed (Fig. 1). The pressure dependence of these anomalies indicates that some transition may exist at around 11 GPa as shown in Fig. 2.

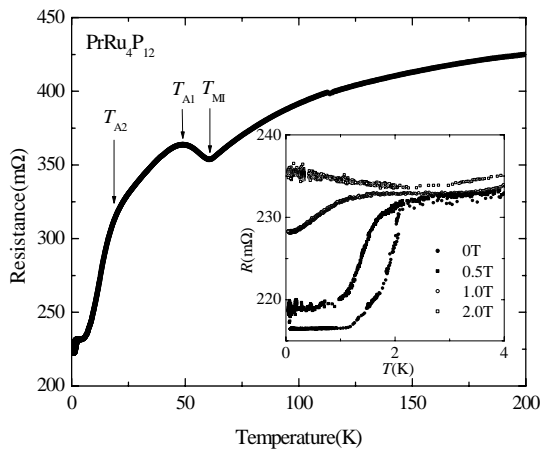


Fig. 1 Temperature dependence of the resistance at 14.7 GPa. The inset shows R vs. T in fields.

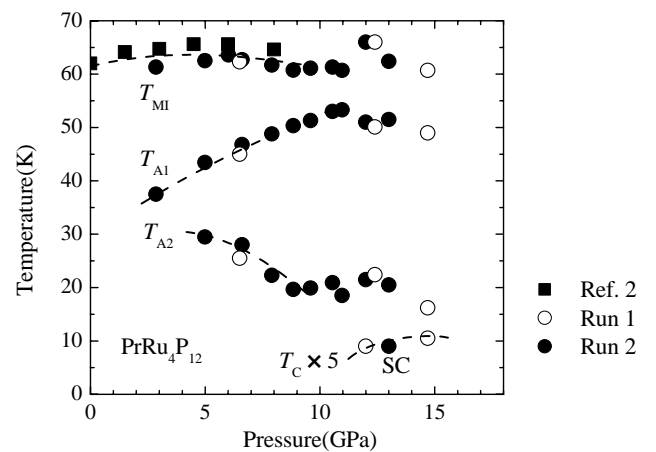


Fig. 2 Pressure dependence of T_{MI} , T_{A1} , T_{A2} and T_c .

[1] C. Sekine, T. Uchiumi, I. Shirotnani and T. Yagi, Phys. Rev. Lett. **79** (1997) 3218.

[2] I. Shirotnani, J. Hayashi, T. Adachi, C. Sekine, T. Kawakami, T. Nakanishi, H. Takahashi, J. Tang, A. Matsushita and T. Matsumoto, Physica B **322** (2002) 408.