Pressure induced superconductivity in a $CeRhSi_3$ single crystal – the high pressure study

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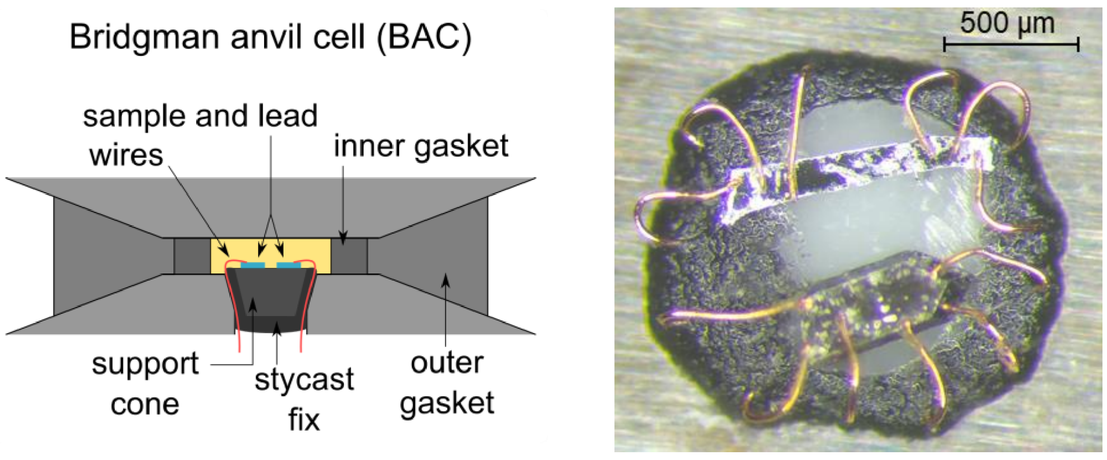
Introduction

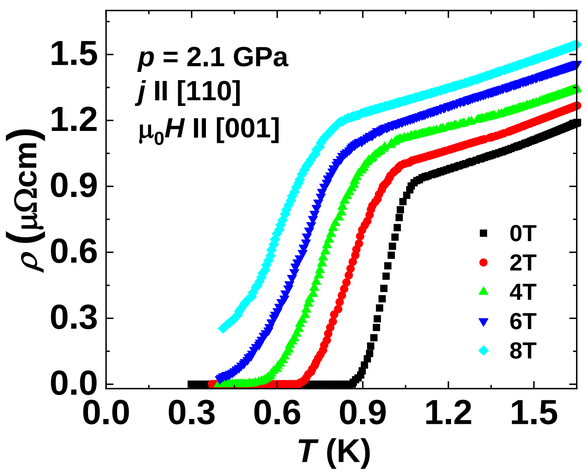
$CeRhSi_3$ is one of very few compounds exhibiting pressure induced superconductivity while possessing crystal structure without an inversion centre (tetragonal $BaNiSn_3$-type *I 4 m m*, no. 107). During the past 15 years, it was studied intensively, but always at limited pressures up to 3 GPa. In this work, we studied the behaviour of the pressure induced superconductivity in yet unexplored region above 3 GPa, by electrical resistivity measurements in varied temperature /magnetic field, employing Bridgman anvil cell and a flux-grown $CeRhSi_3$ single crystal.

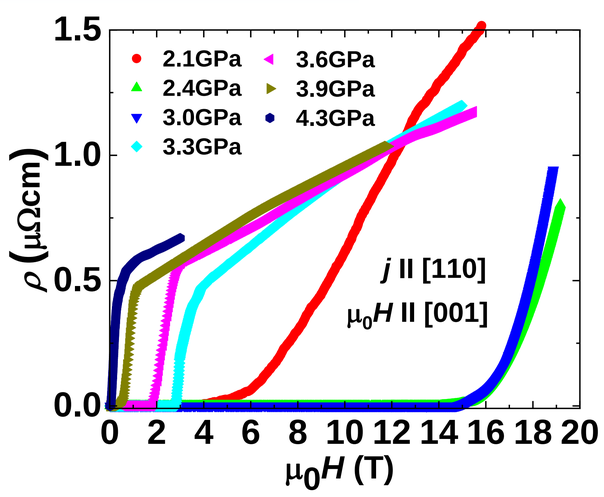
Experimental methods

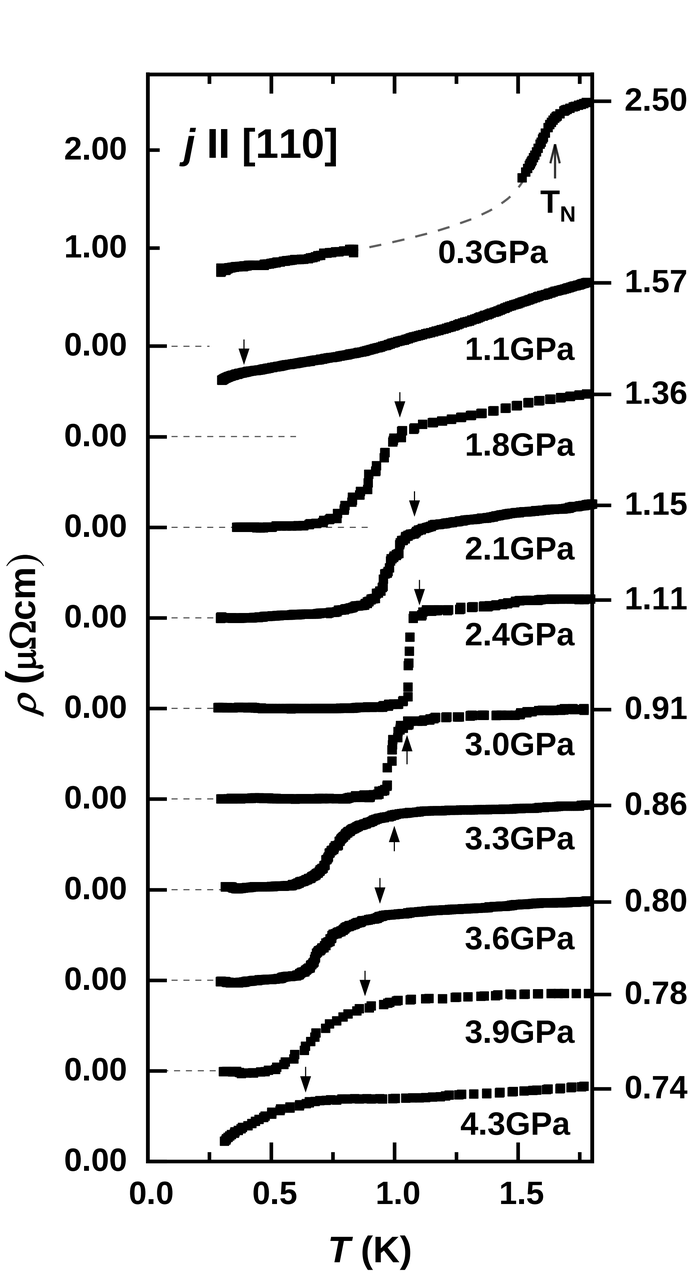


- Bridgman anvil cell with liquid pressure medium (Daphne 7373) and max. pressure of 6 GPa was employed
- Samples grown by Sn-true-flux method (up to 1 mm in length) were checked and oriented by Laue diffraction, characterized at ambient pressure (temperature dependence of electrical resistivity and specific heat) and composition was checked by EDX

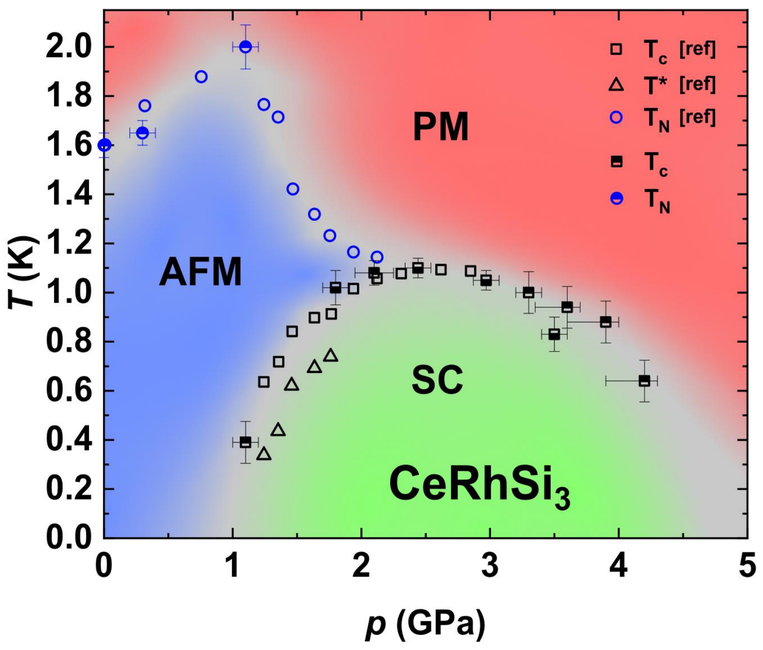
Measurements and results

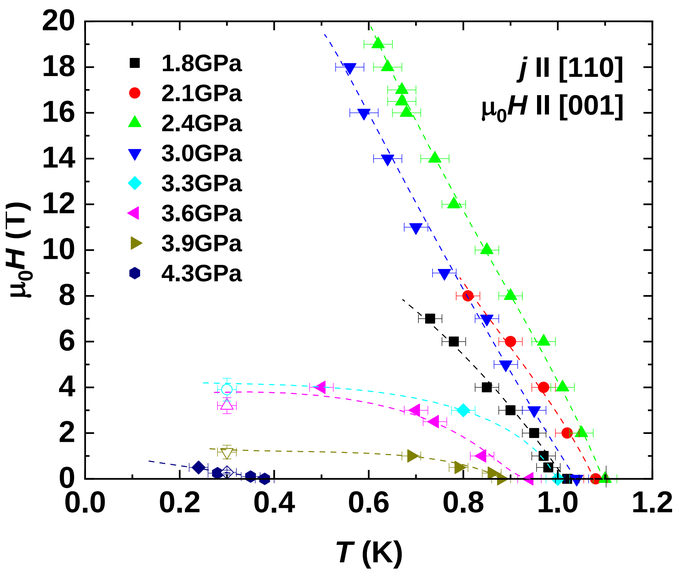






- Temperature dependencies of electrical resistivity in zero field and in various constant magnetic fields were measured, as well as magnetoresistance behaviour.
- Neél temperature increases with pressure at first, but then decreases above 1.1 GPa and is no longer observable after entering the superconducting dome.
- Superconducting transition starts to form at 1.1GPa, reaches maximal critical temperature of 1.1 K between 2.4 and 3 GPa, and is continuously suppressed by further pressure application.
- Measurements in constant magnetic field show a decrease of critical temperature with increasing field.
- Magnetoresitance measurements at the same temperature and different pressures reveal the suppression of critical field with pressures above 3 GPa.





Conclusions

- Pressure induced superconductivity follows a typical dome behaviour.
- Superconducting dome is expected to close between 4.5 to 5.0 GPa.
- Critical field at between 2.4 and 3.0 GPa is especially large, exceeding 19 T at 0.6 K.
- Upon further pressure application above 3 GPa, critical field is quickly suppressed.

[ref] N. Kimura. Y. Muro, and H. Aoki, J. Phys. Soc. Jpn. 76, 051010 (2007)

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