High-Pressure Transport Studies in the Superconducting and Charge Density Wave Material $NbSe_2$

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The transition metal dichalcogenide 2H-$NbSe_2$ has a well-documented charge density wave (CDW) and superconducting transition at 33K and 7K at ambient pressure. The CDW transition is suppressed under high pressure and is absent beyond its quantum critical point (QCP). The effect of this QCP on superconductivity is of great interest and stimulates discussions on the relation between superconductivity and the CDW order. So far, resistivity, magnetic susceptibility, and X-ray measurements have explored the vicinity of this QCP and they indicate a weak relation between superconductivity and the CDW: either a weak competition between CDW order and superconductivity or a weak promotion of superconductivity by fluctuations at the CDW QCP.

In this work, moissanite anvil cells were used to achieve pressures upto 6.8GPa, which could fit inside the bore of the 37.5T magnet at the HFML, Nijmegen, whilst using a ^{3}He cryostat. The anvils were patterned with six gold tracks to simulataneosly measure 4-point longitudinal and transverse resistances.

Here, we present high-pressure magnetoresistance and Hall effect measurements as a clear probe of the CDW order and trace the CDW transition to higher pressures than previously measured with transport methods. Further, the sign-change in the Hall coefficient observed at ambient pressure is suppressed and ultimately saturates to hole-like beyond the CDW QCP. We also observe a peak in the superconducting temperature about the QCP of the CDW of 4.8GPa, which indicates an enhancement of the electron-phonon coupling at the QCP.

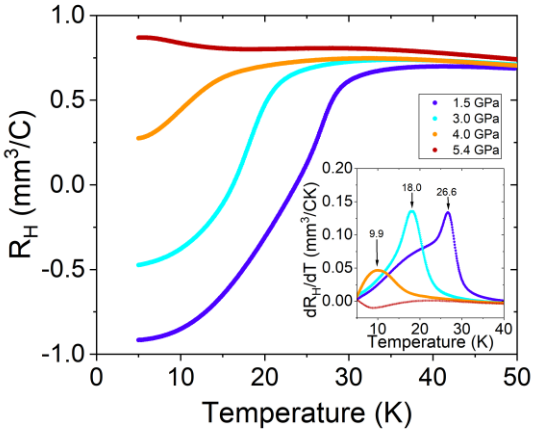

Figure 1. The Hall coefficient vs temperature at selected pressures. Inset shows the derivative, which was used to determined the CDW transition temperature.

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