Transport properties of 1T-TaS$_2$ single crystal

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1T-TaS$_2$ is a quasi-two-dimensional transition-metal dichalcogenide in which charge density wave (CDW) behavior coexists with strong electron electron correlations. Below 180 K, 1T-TaS$_2$ is a Mott insulator in which commensurate CDW orders the tantalum atoms in star-shaped clusters with a long-range superlattice structure. Above the CDW transition temperature, 1T-TaS$_2$ becomes nearly commensurate and a pattern of approximately hexagonal insulating commensurate CDW domains and triangular pieces of metallic phase is formed. We have undertaken a systematic study of the 1T-TaS$_2$ transport properties (particularly the thermal conductivity and the Hall coefficient) from 2 to 360 K, to our knowledge for the first time in both cooling and heating regime in such a wide temperature range.$^{[3,4]}$ The effect of the hysteresis on the transport properties of the compound has also been addressed. We discuss our findings with the main emphasis on the changes in the phonon scattering and charge carriers in the relevant CDW states.

The 27 μm thin sample for the Hall effect measurements has been cut from the larger sample and it shows additional structure in hysteresis loops of both $R_H$ and resistivity $\rho$. This additional structure is probably caused by the small sample preparation. However, the possibility that such details are smeared out in the large sample is not ruled out yet.

We have started a systematic study of the 1T-TaS$_2$ transport properties (particularly the thermal conductivity and the Hall coefficient) from 2 to 360 K, to our knowledge for the first time in both cooling and heating regime in such a wide temperature range.$^{[3,4]}$ We investigated the effect of the hysteresis on the transport properties of the compound. We plan to extend our measurements of thermal conductivity to high pressures and high magnetic fields.

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