An anisotropic temperature independent magnetic susceptibility peak in a van der Waals layer structure $MoSe_{1.8}Te_{0.2}$

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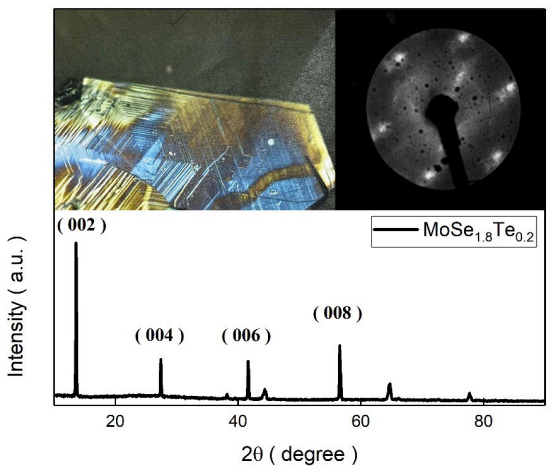
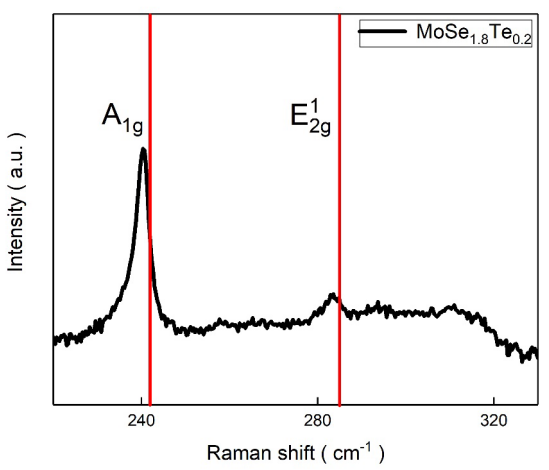
ABSTRACT

- The temperature independent susceptibility peaks were observed at out-of-plane magnetic field in the layered MoSe1.8Te0.2. Magnetic moment splitting between zero-field-cooling and field-cooling processes were found with out-of-plane magnetic field. In contrast, susceptibility peak and ferromagnetism characteristics were not detected with in-plane magnetic field. The susceptibility peaks found were accompanied by ferromagnetism in our samples. According to the high resolution transmission electron microscope images and scanning tunneling spectroscopy, the susceptibility peak originated from the lattice misalignment induced ferromagnetism.

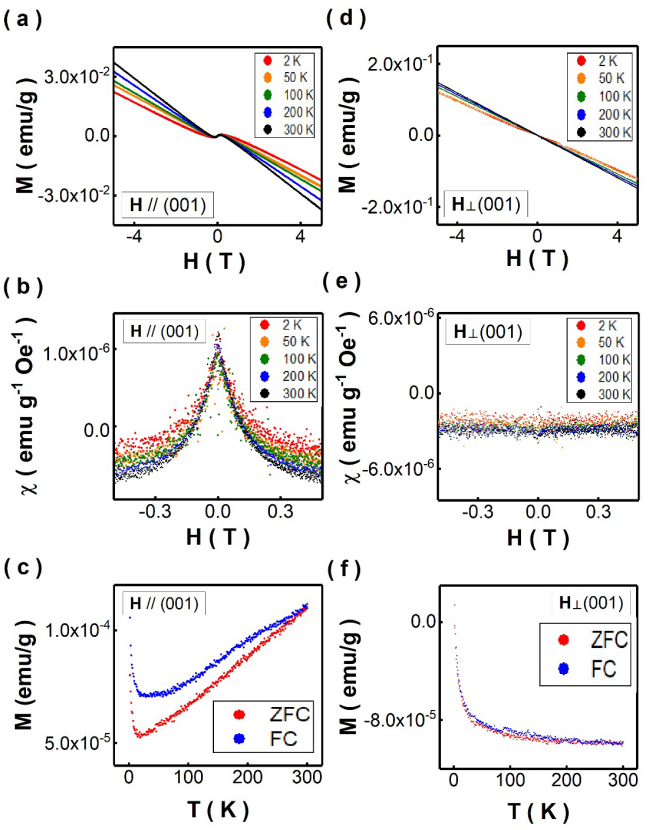
RESULTS



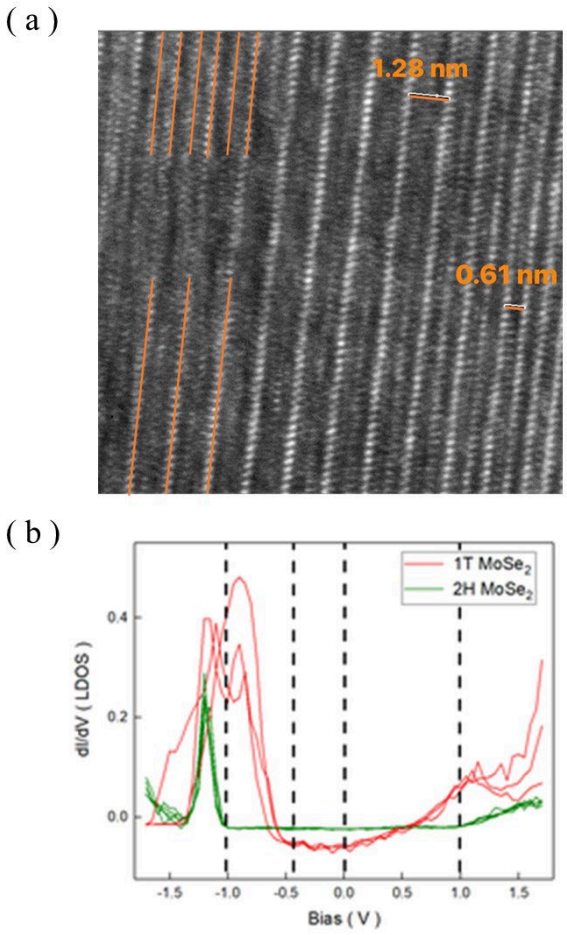
- The top-left inset is the optic image of the MoSe1.8Te0.2.
- The top-right inset is the low energy electron diffraction pattern.
- The XRD spectrum of the MoSe1.8Te0.2. The peak position is consistent with the database.



- The Raman spectrum of the MoSe1.8Te0.2. The peak position is lower than the database of MoSe2, the red line. This originates from the replacement of Te atoms.



- (a), (b), and (c) show the magnetic moment, susceptibility, and the magnetic moment of field cool and zero field cool curves at magnetic field out of layer plane.
- (d), (e), and (f) show the magnetic moment, susceptibility, and the magnetic moment of field cool and zero field cool curves at magnetic field in layer plane.
- These results support the observed susceptibility peak at zero magnetic fields is related to the ferromagnetism.



- (a) The HRTEM of the MoSe1.8Te0.2. The lattice distance of 2H structure is 1.28 nm and the lattice distance of 1T structure 0.61 nm.
- (b) The scanning tunneling spectroscopy of the MoSe1.8Te0.2 at different areas. It shows the two energy gaps with 2 eV and 0.5 eV. This confirms the co-existence of the 2H and 1T phases.

CONCLUSIONS

- The susceptibility is determined at different magnetic field orientation in the layered MoSe1.8Te0.2.
- The temperature independent susceptibility peaks is observed at magnetic field out of the layer plane, and no susceptibility peaks are observed at magnetic field in the layer plane.
- The magnetic moment of zero field cool and field cool splits with magnetic field out of the layer plane while overlapping with magnetic field in the layer plane. The susceptibility peaks were accompanied by ferromagnetism. This supports the temperature independent susceptibility peaks should not originate from the reported topological spin texture or unavoidable magnetic elements.
- According to the high resolution transmission electron microscope image and scanning tunneling spectroscopy, the observed susceptibility peak should originate from the lattice misalignment induced ferromagnetism.