Abstract

Transition metal dichalcogenides (TMDs) such as Fe₃NbS₆, an antiferromagnet, have demonstrated electrical switchability. In this study we will present findings of VₓNbS₂₋ₓ, a TMD, to show its antiferromagnetic transitions and the possibility of electrical switchability through transport, magnetization on nanofabricated devices.

Background

Transition Metal Dichalcogenides (TMDs) are studied in particular for their characteristics that include superconductivity, magnetism, charge density waves (CDW), and Mott Physics [1]. The band gap within these Van der Waals layered materials provides the opportunity for the creation of new applications such as memory based devices [2].

Methods

Synthesis of VₓNbS₂

- Precursor made by sealing a quartz tube filled with Ar and placed within a box furnace. Precursor was made with stoichiometric amounts of vanadium, niobium and sulfur.
- The precursor would next be transferred into a new quartz tube with iodide to be placed within a two zone furnace for chemical vapor transport (CVT).

Characterization

- Dispersive Spectroscopy (EDS/EDX) and Focused Ion Beam (FIB). [4]
- Each sample was measured with Quantum Design Physical Property Measurement System (PPMS) for transport measurements. [5]
- Each sample was measured with Scios TM 2 DualBeam™ for Materials Science. [6]
- These graphs show the Resistivity vs Magnetic Field for channel Rxy at varying temperatures for AG4083. [A: 10-60K, B:3-40K]

Results and Discussion

- We were able to see signatures related to a transition through transport measurements in VₓNbS₂. 
- Based on both the Resistance vs Temperature and the Resistivity vs Temperature data we were able to verify previous studies that demonstrate that VₓNbS₂ is an antiferromagnet.
- Figure 9 displays a hysteresis and anomalous hall effect at varying temperatures.

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References


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