Growth and Characterization of 2D Magnetic Materials

Patel, Taksh (School: Fayetteville High School)

Both, MnPS3 and GdPS, have been researched due to the recent insight into 2D magnetism and topological states. The ZrSiS family (GdPS belongs to this family) can be used as topological materials through elemental substitution and strain application. On the other hand, MnPS3 belongs to the MPX3 family (M is a transition metal and X is a chalcogen). Both crystals are synthesized through the CVT (chemical vapor transport) method. GdPS is heated till 1075-975 °C in a furnace for 1 week. The same can be said for MnPS3, but the material is heated to 650-600 °C for 1 week. Then, the material composition and the crystal structure are determined through XRD (X-ray Diffraction) and EDS (Energy-Dispersive Spectroscopy). Finally, the temperature dependence of the magnetic susceptibility is measured by putting both samples in the PPMS (Physical Property Measurement System) and applying a magnetic field out of the plane (H||c) and in-plane(H||ab) magnetic fields. Both materials exhibit a Néel temperature. For GdPS, the Néel temperature is around 7 K. For MnSP3, the temperature is around 78 K. Therefore, both crystals display antiferromagnetic properties before their respective Néel temperatures. As a result, they can be used as superconductors below the Néel temperature. They are used in spintronics and thin layered magnetic fields due to their magnetic anisotropy.

Awards Won:
King Abdulaziz &amp
his Companions Foundation for Giftedness and Creativity: Full Scholarship from King Fahd University of Petroleum and Minerals(KFUPM) (and a $400 cash prize)
King Abdulaziz &amp
his Companions Foundation for Giftedness and Creativity: NOT TO BE READ -- $400 cash prize for each Full Scholarship from King Fahd University award recipient