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Band topology evolution and signatures of Lifshitz transition in $WTe_{2:08}$ nanosheets

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Weyl semimetals have recently attracted a lot of attention due to its unique electronic band structure. They are analogs to Graphene in 3D with vanishing density of states at the band touching point with linearly dispersing energy-momentum relation. The Weyl semimetals are protected by the topological property of the Weyl nodes which act like the source of Chern fluxes in the momentum space. The projection of Weyl nodes on to the surface Brillouin Zone gives rise to Fermi arcs. The unusual band topology of Weyl semimetals is predicted to exhibit different quantum phenomena. Weyl semimetals are further classified into type-I and Type-II based on their band structures. WTe_2 is a newly discovered type-II Weyl semimetal known for extremely large magnetoresistance. Shortly, after the discovery, several experiments came up with the results where a bulk WTe_2 crystal is electronically a lot different from a monolayer.

Here, I will discuss the evolution of band topology of Weyl semimetal $WTe_{2.08}$ nanosheets through transport analysis. We observed a resistivity anomaly in ρ_{xx} Vs. T curve which has not been seen in WTe_2 systems. The resistance anomaly temperature increases as the thickness increases implying the suppression of one type of carrier in the semimetallic band. The evolution of Hall data from non-linear to linear with the decrease of thickness suggests the shifting of the energy bands i.e., from a two-carrier system to a single carrier system. The single carriers being hole carriers suggests the downward shift of the Fermi level. Along with that, we also observed the temperature dependance of individual samples where for thicker samples the Fermi level moves from two bands to a single band system as the temperature increases. At the resistivity anomaly temperature (T^*), where the system enters from a two-carrier system to a one-carrier system signals the presence of a Lifshitz transition. Combining with Hall data and zero-field resistivity Vs. T behavior, we identify the contributions from a semiconducting and a semimetallic band. Finally, our experiments provide an insight into the band structure sensitivity of the WTe_2 system towards thickness and temperature along with that a slight variation of composition which might be the possible reason for its unusual and divergent behaviour.

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