Investigation of topological nodal line semimetal: $ZrAs_2$

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Recent studies have shown potential applications of topological nodal line semimetals in electronics and spintronics due to their unique electronic properties [1]. $ZrAs_2$ is one of the examples of nodal line semimetals. We have grown high quality single crystals of $ZrAs_2$ using chemical vapor transport method with iodine as a transport agent. We performed low temperature electron transport on obtained needle-like single crystals. $ZrAs_2$ exhibits extremely large magnetoresistance $\sim 3.5 \times 10^4$ % at 5 K and up to 14.5 T. One of the intriguing facts is that it shows pronounced Shubnikov de Haas (SdH) oscillations above 9 T as shown in Fig. 1 (a). SdH oscillations are systematically investigated showing existence of two bands in fast Fourier transform of SdH oscillations. Quantum oscillation study is not reported on the materials of this family yet. To have deep understanding of electronic properties, we also investigated Fermi surface of $ZrAs_2$ by ARPES, obtained results are consistent with DFT calculations. ARPES results show existence of two prominent pockets contributing to overall electronic properties of $ZrAs_2$ (see Fig. 1 (b)).

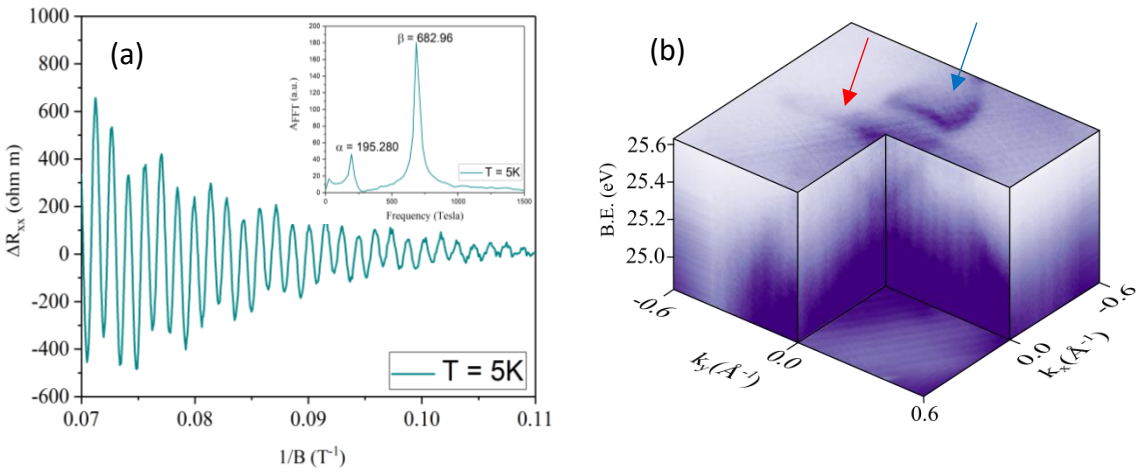

Fig. 1. (a) Shows existence of Shubnikov De Haas (SdH) oscillations at 5 K extracted by subtracting background data. (Inset) fast Fourier transform of SdH oscillations showing two peaks indicating presence of two types of Fermi pockets (indicated by red and blue arrows) in this material, and (b) 3D Fermi surface with vertical scale showing binding energy of $ZrAs_2$ obtained by experimental ARPES studies.

[1] J. Bannies, E. Razzoli, M. Michiardi, H.-H. Kung, I. S. Elfimov, M. Yao, A. Fedorov, J. Fink, C. Jozwiak, A. Bostwick, E. Rotenberg, A. Damascelli, and C. Felser, Phys. Rev. B 103, 155144 (2021).