TUNING THE TOPOLOGICAL ELECTRONIC STATE IN Au_2Pb USING APPLIED PRESSURE

K. W. Chen[1,2], D. Graf[1], T. Besara[1], A. Gallagher[1,2], N. Kikugawa[1,4], L. Balicas[1] , T. Siegrist[1,3] , A. Shekhter,[1] R. E. Baumbach[1]

[1]National High Magnetic Field Laboratory, Florida State University
[2]Department of Physics, Florida State University
[3]Department of Chemical and Biomedical Engineering, Florida State University and
[4]National Institute for Materials Science, 3-13 Sakura, Tsukuba, Japan

A topological insulator is a bulk insulating material with an electrically conducting non-trivial topologically ordered surface state that preserves time reversal symmetry. Such systems are characterized by the presence of a linearly dispersing electronic band**[1]**. While intense interest has been directed towards a set of “prototypical” TI materials such as $Bi_2(Se,Te)_3$ **[2]**, widespread exploration of the chemical phase space remains in its infancy. Even less well known is how topological states interact with more conventional metallic states: e.g. Fermi liquid behavior, superconductivity, and magnetism. We report the temperature (T) - pressure (P) phase diagram for the cubic Laves phase compound Au_2Pb, which was recently proposed to be a promising candidate for the exploration of nontrivial electronic behavior in a metallic host **[3]** owing to the presence of a bulk Dirac cone that coexists with conventional quadratic bands at room temperature. With decreasing temperature there are three structural phase transitions at T_1 = 97 K, T_2 = 51 K and T_3 = 40 K, which may result in a distinct topological state at low temperatures. As evidenced by electrical resistivity and heat capacity measurements, superconductivity occurs for temperatures below T_c = 1.2 K. We show that applied pressure results in a rich phase diagram, where T_1, T_2 and T_3 evolve strongly with P and a new phase is stabilized for P > 0.64 GPa with superconductivity persisting below 1.1 K. Shubnikov-de Haas (SdH) oscillations are visible for temperatures up to 15 K at both ambient pressure and under 1GPa, where changes in the oscillation frequencies indicate distinct Fermi surfaces between the two phases. By fitting the SdH oscillations, we investigate the possible existence of a linearly dispersing Dirac band both at ambient and high P, which could yield a finite Berry phase.

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Email:ckuanwen@gmail.com