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Superconductivity in a Topological Dirac Nodal-Line Semimetal

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Topological electronic materials, especially Dirac nodal-line semimetals (DNLSs), have been attracting attention in condensed matter physics. DNLSs have gapless nodal-line Dirac dispersions along the specific momentum-directions in the electronic band structures, which are protected by the nonsymmorphic symmetry of the crystal structures even under the strong spin-orbit-interaction (SOI). ZrSiS and InBi are the DNLSs, belonging to the nonsymmorphic space group P4/nmm. They are known to exhibit large magnetoresistance (MR) due to the existence of the Dirac line node. $LaAgBi_2$ (shown in Fig. 1(a)) was reported to exhibit large MR [1]. Recently, we found that $LaAgBi_2$ was also the DNLS [2] from the fact that it belongs to the same P4/nmm space group and has strong SOI from Bi. As shown in Fig. 1 (b), it should be noted that the Dirac dispersion exactly crosses at the Fermi energy in $LaAgBi_2$.

In this study, we explored the possibility of superconductivity in $LaAgBi_2$ as a DNLS. High-quality single crystals of $LaAgBi_2$ were obtained by the self-flux method. As shown in Fig. 1 (c), our sample of $LaAgBi_2$ exhibited the higher residual resistivity ratio of 131 and the larger magnetoresistance of 2400% at 2 K and 9 T than those of previous studies (10 and ~1200%, respectively [1]). Furthermore, we found that the resistivity dropped rapidly below 2 K (inset of Fig. 1 (c)). As increasing the applied magnetic fields, the resistivity-drop was suppressed, indicating the resistivity behavior below 2 K is due to superconductivity. We will report the details of superconducting properties, including anisotropy, at lower temperatures.

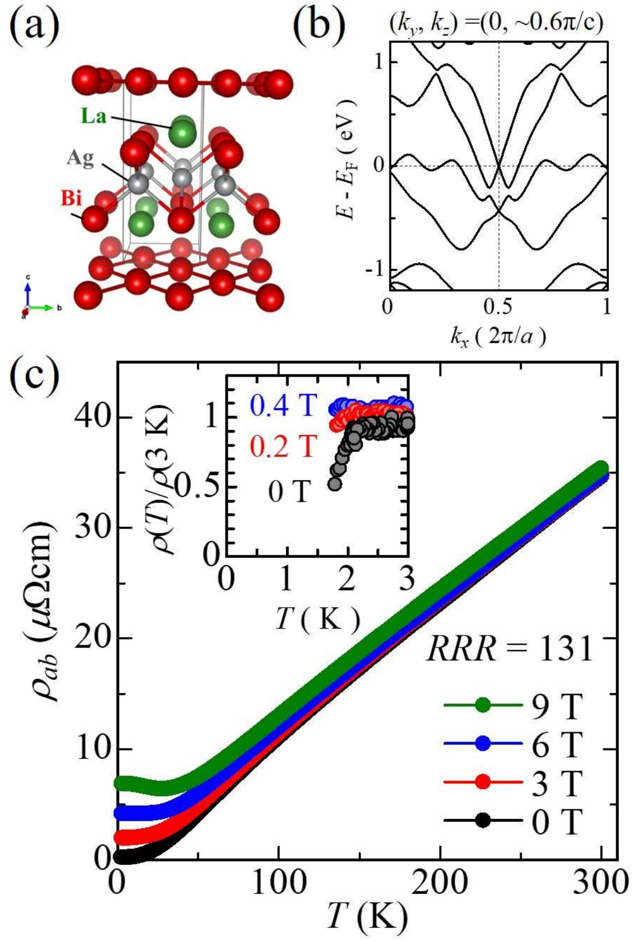

Fig. 1 (a) The crystal structure of $LaAgBi_2$. (b) The electronic dispersions plotted along the k_x direction at the fixed (k_y, k_z) = (0, ~0.6π/c). (c) Temperature dependence of resistivities under various magnetic fields. Inset: The plot of $\rho(T)/\rho(3\text{ K})$ versus temperature below 3 K.