Superconductive density-of-states (DOS) depletion effect manifested in interlayer magnetotransport of overdoped Bi-2212

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— To determine the mechanism of high superconducting transition temperature (high-$T_c$) superconductivity, we must understand the relationship between the pseudogap (PG) and superconductivity. For this purpose, we measure the out-of-plane resistivity $\rho_c (T, H)$ of an overdoped Bi$_{1.6}$Pb$_{0.4}$Sr$_2$CaCu$_{1.96}$Fe$_{0.04}$O$_{8+\delta}$ (Bi-2212) single crystal under pulsed magnetic fields up to 60 T. Above $T_c$, magnetoconductivity (MC) is due to two positive components: one component rapidly increases with increasing fields but saturates at higher fields, and the other component gradually increases as $H^2$. The former decreases with increasing temperature and vanishes around the onset temperature of superconductive fluctuation $T_{scf}$. Thus, it is attributed to the superconductive DOS depletion effect. The latter is present both below and above $T_{scf}$. Thus, it is attributed to the PG effect. Subsequent analysis below $T_c$ shows that the peak structure for $\rho_c (T, H)$ is primarily due to the superconductive DOS depletion effect. This result supports the scenario that the PG results in high-$T_c$ superconductivity.

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