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Anomalous dependence of interface superconductivity on carrier density in metal-insulator bilayer JIE WU, Brookhaven National Laboratory & National High Magnetic Field Laboratory, OSHRI PELLEG, GENNADY LOGVENOV, ANTHONY BOLLINGER, Brookhaven National Laboratory, GREG BOEBINGER, National High Magnetic Field Laboratory, IVAN BOZOVIC, Brookhaven National Laboratory — The interface superconductivity is of particular interest for its higher superconducting temperature (Tc) and close connection to the HTS study. However, despite of the experimental and theoretical progress, the answer to the following key question still remains ambiguous: can the underlying mechanism of the interface superconductivity be interpreted solely in terms of charge transfer and Sr interdiffusion? One experimental approach to answer this question is to study the dependence of Tc on the carrier density of $La_{2-x}Sr_xCuO_4/La_2CuO_4$ (LSCO/LCO) bilayer by changing the doping level in the metallic LSCO layer. The charge transfer and cation interdiffusion at the interface is proportional to the carrier density in LSCO layer; therefore, Tc of the interface is expected to show a significant and non-monotonic dependence on the carrier density. To exam this prediction, we synthesized a series of $La_{2-x}Sr_xCuO_4/La_2CuO_4$ bilayers with x ranging in 0.27 to 0.47 by atomic layer-by-layer molecular beam epitaxy (ALL-MBE). The uniqueness of these samples is a 4% Sr doping gradient of the central doping level across the 10mm width of the substrate. These combinatorial samples realize an extremely fine tuning of doping and enable us to construct a phase diagram that is 30 times denser than a normal method can achieve.

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