Electronic structure of the ingredient planes of Bi$_2$Sr$_2$CaCu$_2$O$_8$+$\delta$ and Bi$_2$Sr$_2$CuO$_6$+$\delta$ superconductors\textsuperscript{1}

XUCUN MA, Department of Physics, Tsinghua University — Understanding the mechanism of high transition temperature superconductivity in cuprates has been hindered by the apparent complexity of their multilayered crystal structure. Using a cryogenic scanning tunneling microscopy (STM), we report on layer-by-layer probing of the electronic structures of the ingredient planes (BiO, SrO, CuO$_2$) of Bi$_2$Sr$_2$CaCu$_2$O$_8$+$\delta$ (Bi-2212) and Bi$_2$Sr$_2$CuO$_6$+$\delta$ (Bi-2201) superconductors prepared by argon-ion bombardment and annealing (IBA) technique. We show that the well-known pseudogap (PG) feature observed by STM is inherently a property of the charge reservoir planes and thus irrelevant directly to Cooper pairing. The CuO$_2$ planes are exclusively characterized by a small gap inside the PG. The small gap becomes invisible near $T_c$, which we identify as the superconducting gap. The results constitute severe constraints on any microscopic model for high $T_c$ superconductivity in cuprates. Contributors: Yan-Feng Lv, Wen-Lin Wang, Hao Ding, Yang Wang, Yong Zhong, Ying Ding, Ruidan Zhong, John Schneeloch, Gen-Da Gu, Lili Wang, Ke He, Shuai-Hua Ji, Lin Zhao, Xing-Jiang Zhou Can-Li Song, and Qi-Kun Xue.

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