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Topological transport and atomic tunneling-clustering dynamics for aged Cu-doped Bi_2Te_3 crystals FENGQI SONG, TAISHI CHEN, WENKAI HUANG, ZHAOGUO LI, XUEFENG WANG, Nanjing University, COLLABORATIVE INNOVATION CENTER OF ADVANCED MICROSTRUCTURES COLLABORATION — Here we report the suppression of the bulk conductance of the material by four orders of magnitude by intense aging in $(Cu_{0.1}Bi_{0.9})_2Te_{3.06}$ crystals. The weak antilocalization analysis, Shubnikov de Haas oscillations and scanning tunneling spectroscopy corroborate the transport of the topological surface states. The aging method therefore leads to an optimized band-insulating TI crystal and appeals to a free-of-IB crystal. STM visualizes the novel defect features of Cu dopants and their dynamics during the aging process, based on which the details of the aging process are further revealed by ab initio calculations. These calculations suggest that there exists a diffusion barrier at the interface of the Bi_2Te_3 QLs. During the aging process, Cu atoms freely migrate inside the QLs and frequently hit the barrier. The dopant atoms will also form clusters in between the QLs, leaving disorder within the QLs. This leads to a pronounced mobility suppression of the bulk electrons, finally allowing the observation of the TSS-related electron transport in bulk crystal samples. An atomic tunneling-clustering picture across a diffusion barrier of 0.57eV is proposed. (Nature Commun. 5, 5022(2014))

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