Interfacial nanobubbles induce doping behavior of SL-MoS_2 on Au(111)

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Abstract

Transition Metal Dichalcogenide (TMD) with atomic-scale thickness exhibit unique property such as layer-dependent electronic and strain-induced bandgap variations. In recent years, peeling had been demonstrated to be a mature and efficient transfer technic to fabricate advanced devices. However, during the peeling process, inevitable damage to the TMD surface can occur, which cause the defect to emerge and subsequently compromising the overall reliability and performance after further fabrication of devices.

In this work, we investigated monolayer MoS_2 on Au under different vacuum conditions by the means of scanning tunnelling microscopy/spectroscopy (STM/S). After transfer and peeling, we could clearly observe atomic signal with hole-like defects on MoS_2/Au for Au deposition under 10^{-6} torr. In contrast, the defects become convex for Au deposited under 10^{-7} torr. Further STM analyze confirm that this convex defect could attributed to the nanobubbles at the MoS_2 and Au interface, which result from the stronger interlayer bounding that effectively prevent MoS_2 been reap off during peeling process. More, these nanobubble on MoS_2 also give rise to local strain that led to a strong n-type bandgap reduction, with a similar effect to the doping technic. Our finding reveals a local strain induced doping behavior on MoS_2/Au. Which provide a potential method to tune the local electron property of 2D semiconductor, and pave the way for future contact research on metal-2D systems.

Keywords - scanning tunnelling microscopy/spectroscopy, nanobubble , 2D material.