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Spin-orbit coupling induced by band hybridization in Graphene/WS2 heterostructures[1] BOWEN YANG, UCR, MIN-FENG TU, Caltech, JEONGWOO KIM, UCI, YONG WU, UCR, JASON ALICEA, Caltech, RUQIAN WU, UCI, MARC BOCKRATH, JING SHI, UCR — Graphene are known to have a negligibly small intrinsic spin-orbit coupling (SOC), however, many novel physical phenomena such as the quantum spin Hall effect and the quantum anomalous Hall effect have been predicted if strong SOC exists in graphene. Despite that many theoretical studies have been carried out on the enhancement of the SOC strength in graphene, few experiments have been conducted to confirm the existence of and investigate the physical origin of the enhanced SOC in graphene. Here we demonstrated the introduction of SOC into graphene through the proximity effect by stacking WS2 onto graphene. We studied the magnetoconductance of graphene and found weak antilocalization emerges when graphene is covered by WS2. This is in a clear contrast with the weak localization behavior observed in bare graphene and thus provides an unambiguous evidence of the induced Rashba SOC. By focusing on a high carrier density region, we showed that it is possible to reliably extract the strength of Rashba SOC. Furthermore, via investigating the electric field dependence of the Rashba SOC with a dual-gate device, we found that the origin of this enhanced SOC is the band hybridization between graphene and WS2, in agreement with our theoretical calculations.

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