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Weak localization and weak anti-localization in graphene with in-situ hydrogenation[1] JIAN-HAO CHEN, CHAO-YI CAI, CHUAN-WU CAO, SHI-MIN CAO, International Center for Quantum Materials, School of Physics, Peking University, and Collaborative Innovation Center of Quantum Matter, Beijing 10087, INDRA YUDHISTIRA, SHAFFIQUE ADAM, The Yale-NUS College, 16 College Avenue West, Singapore 138527, HAIWEN LIU, Center for Advanced Quantum Studies, Department of Physics, Beijing Normal University, Beijing, 100875, China
— The attachment of adatoms to two dimensional materials could strongly modify the electronic properties and induce various new physics not present in these materials in the pristine form. We have measured the low field magnetoresistance (MR) of graphene at low temperature with in-situ hydrogenation in ultra-high vacuum environment. A cross-over from weak localization (WL) to weak anti-localization (WAL) is observed which closely resemble 2DEG with increasing Rashba interactions and metal thin film with increasing spin-orbit coupling. By analyzing the WL and WAL at different carrier concentration, hydrogen concentration and temperature, we have been able to identify hydrogenation as the source of increased electron dephasing and enhanced spin-orbit coupling strength in graphene.

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