Tuning electronic characteristics of MoS_2-Au heterostructures via twist angle manipulation: STM insights

Ishita Pushkarna, Árpád Pásztor, and Christoph Renner

DQMP, Université de Genève, 24 Quai Ernest Ansermet, CH-1211 Geneva, Switzerland

Transition metal dichalcogenides, exemplified by molybdenum disulfide (MoS_2), have undergone extensive examination on metal surfaces. However, scant attention has been paid to these fundamental heterostructures' twist angle-dependent electronic characteristics. This aspect presents considerable potential for the creation of functional quantum materials. Within this discourse, we will delve into a comprehensive investigation utilizing scanning tunneling microscopy and spectroscopy to scrutinize the electronic traits of monolayer MoS_2 interfacing with gold, focusing on twist angle variations.
Our findings reveal a noteworthy modulation of the semiconductor band edges and consequent band gap in correspondence with the moiré wavelength, which arises from the interaction between MoS_2 and gold. Notably, this modulation diminishes progressively as the twist angle increases. We attribute these observations to the hybridization between the nearest gold and sulfur atoms, which exhibits greater spatial uniformity as the twist angle enlarges [1].

[1] I. Pushkarna, A. Pásztor, and C. Renner, "Twist-angle-dependent electronic properties of exfoliated single layer MoS_2 on Au(111)," Nano Letters, vol. 23, no. 20, pp. 9406-9412, 2023.