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Visualizing Anisotropic Strain and Electronic Structures in WSe_2-MoS_2 Lateral Heterojunctions CHENDONG ZHANG, University of Texas at Austin, MING-YANG LI, King Abdullah University of Science and Technology, YIMO HAN, Cornell University, YUSHAN SU, University of Science and Technology of China, LAIN-JONG LI, King Abdullah University of Science and Technology, DAVE MULLER, Cornell University, JERRY TERSOFF, IBM Research Division, T. J. Watson Research Center, CHIH-KANG SHIH, University of Texas at Austin — Recent demonstrations of seamless 2D lateral heterojunctions (HJs) based on dissimilar monolayer transition metal dichaldogenides (TMDs) have created new opportunities to push semiconductor heterostructures toward a new frontier. By using scanning tunneling microscopy and spectroscopy, we investigate the atomic structures and electronic properties of the atomically abrupt lattice-mismatched lateral HJs of WSe_2-MoS_2. We present a novel method to determine the anisotropic strain based on Moiré pattern imaging. The 2x2 strain tensor is imaged with nanometer spatial resolution. We show that the misfit dislocations at the interface are responsible for partial relaxation of the strain. Transmission electron microscopy reveals two kinds of misfit dislocations, one with Burger's vectors along the zigzag direction parallel to the interface, and the other one also along the zigzag direction but at 60 degrees off the interface. We also determine the band offset across the junction and show that the strain effect converts the otherwise type-II into type-I band alignment. Moreover, a "line interface specific" electronic structure due to the specific bonding configuration is discovered at the interface.

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