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Visualizing a p-n junction of two-dimensional electronic gases on a polar semiconductor BiTeI YUHKI KOHSAKA, RIKEN CEMS, MANABU KANOU, Tokyo Tech., TETSUO HANAGURI, RIKEN CEMS, HIDENORI TAKAGI, Univ. of Tokyo/MPI, TAKAO SASAGAWA, Tokyo Tech. — We report atomically-resolved spectroscopic imaging studies of bipolar two-dimensional gases and their junction on the surface of a polar semiconductor BiTeI with a scanning tunneling microscope. Topographic images of pristine and substituted samples reveal that this material shows domain structures composed of opposite stacking orders, Te-Bi-I and I-Bi-Te. We find that electrons are accumulated on Te-face and holes on I-face by elaborating electronic standing waves on the surfaces of each domain, and show atomic resolution imaging of a p-n junction on the domain boundary. Given that no chemical modifications such as surface contamination and additional defects are observed, the origin of the bipolar two-dimensional carriers as well as the formation of the domain structures are ascribed to spontaneous electric polarization in the bulk. Our results indicate that, besides chemical doping and electrostatic gating, spontaneous electric polarization can induce bipolar carriers, and demonstrate a platform to study spin-split two-dimensional p-n junction and edge states at atomic resolution.

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