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Potential and piezoelectric response imaging of 180° domain of atomically ordered clean surfaces of $BaTiO_3$ single crystals in UHV YUKIO WATANABE, Kyushu University, S. KAKU, D. MATSUMOTO, S.W. CHEONG, Rutgers Uinv. — We report the electrostatic and piezoelectric properties of the clean, free surface of $BaTiO_3$ single crystal in ultra high vacuum (UHV) The topographic imaging by AFM confirmed that the surface is atomically wellordered exhibiting clear one-lattice-height atomic steps. The amplitude and the phase image of piezoelectric response microscopy (PFM) identified 180° domains. The electrostatic potential mapping by Kelvin force microscopy (KFM) of these domains revealed that the shapes of the domains agreed exactly with the PFM images, which confirms the correctness of the standard 180° domain theory and disagrees with closure domains. However, the potential difference of upward and downward domain is approx. 0.1V, which is 100 times smaller than the value estimated by the standard theory. Similar measurements with changing temperature across Curie temperature show that this result cannot be explained by the compensation of the spontaneous polarization by contamination or oxygen deficiency or ionic conduction). The present results suggest that an intrinsic electrostatic shielding mechanism exists for 180° domains, which is consistent with the reports of surface electron/hole layers [1].

[1] Watanabe et al. *PRL***86**332(2001);*Ferroelectr.*367, 23(2008) We acknowledge JSPS No.19340084.

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