Supplementary information: Influence of Fermi level pinning on contact potential difference measurements using Kelvin probe force microscopy

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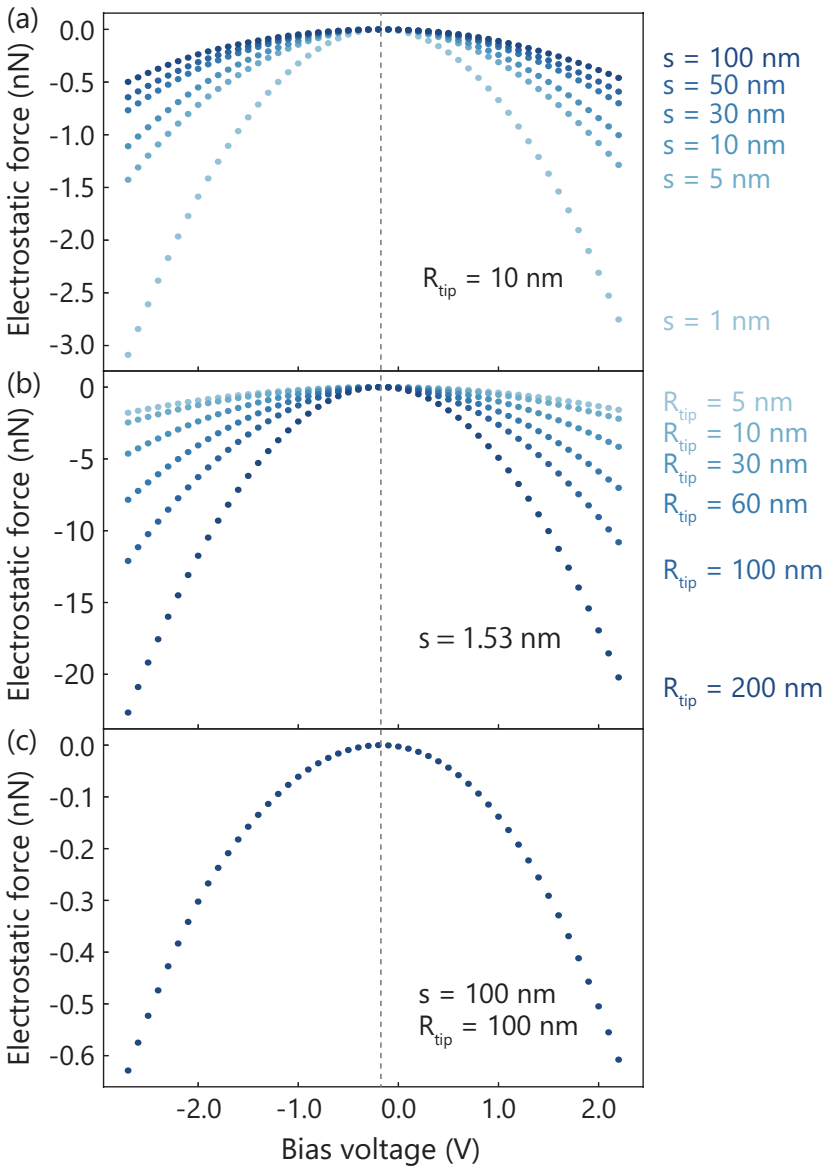

FIG. S1: To examine the generality of the high surface sensitivity of KPFM discussed in Section IIIA in the main article, we calculated the electrostatic force as a function of bias voltage for larger tip-sample separations (s) and tip radii (R_{tip}) under the strong Fermi level pinning condition. In (a), the calculations were performed while keeping R_{tip} constant at 10 nm and varying s from 1 to 100 nm. In (b), the results were obtained by keeping s constant at 1.53 nm and varying R_{tip} from 5 to 200 nm. In (c), calculation was performed using large values for both s and R_{tip} (100 nm and 100 nm, respectively). The vertical dashed line indicate the values of V^{*}_{CPD}. In all cases, the magnitude of the electrostatic force and the curvature of the $F_{\mathrm{elec}}(U)$ spectra exhibited significant dependence on s and R_{tip}. However, U^{*}, bias voltage at which the electrostatic force is minimized, remained nearly unchanged.

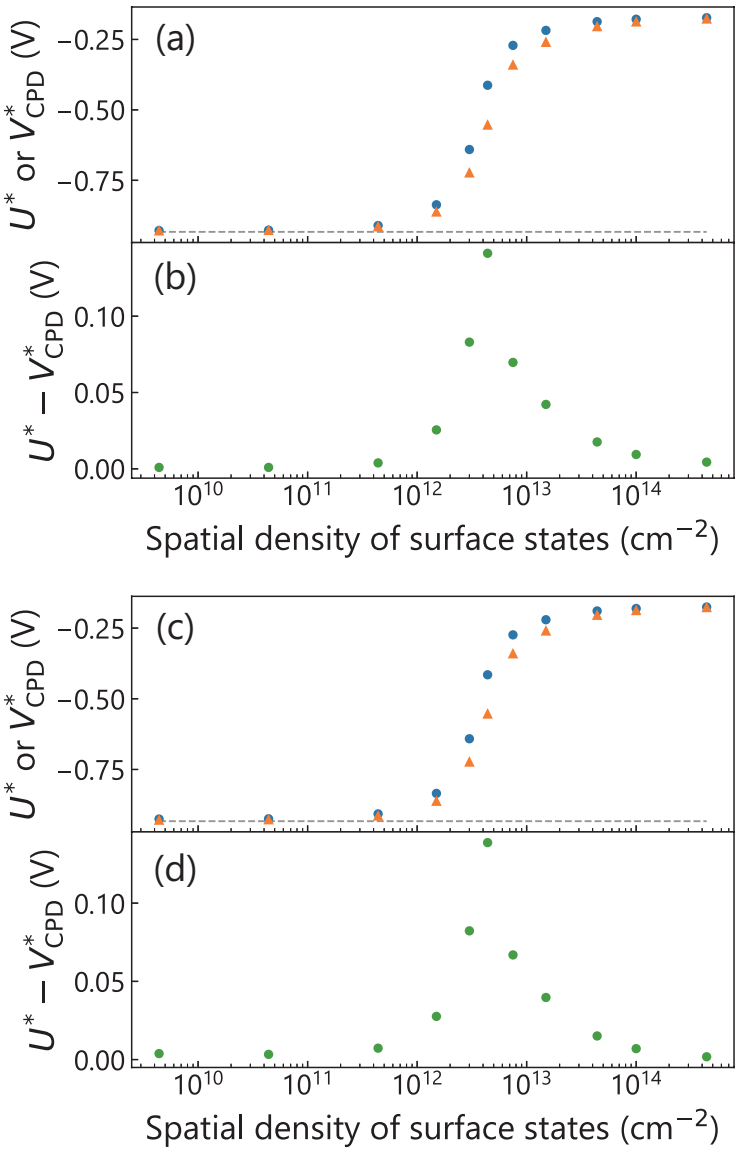

FIG. S2: To examine the generality of the results shown in Fig. 4 in the main article, we calculated U^* and for larger s and $R_{\rm tip}$ while varying the DOS of the surface states. (a) and (b) shows the results obtained using $s = 100$ nm and $R_{\rm tip} = 10$ nm, and (c) and (d) show the results obtained using $s = 100$ nm and $R_{\rm tip} = 100$ nm. In (a) and (c), solid circles and triangles represent the values of U^* and $V^*_{\rm CPD}$, respectively, plotted as a function of $\rho_{\rm ss}$. The dashed horizontal line indicates the value of $V^*_{\rm CPD}$ for the pristine GaAs(110) surface. (b) and (d) show the differences between U^* and $V^*_{\rm CPD}$ values.