Supplementary information

Single-electron charge sensing in self-assembled quantum dots

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Estimation of the lever-arm factor for a quantum dot weakly tunnel-coupled to reservoirs

In Fig. 3(c) in the main text, we show the N+1 state fraction of the quantum dot QD_2 in sample A as a function of the dot chemical potential μ_{QD2}. Although the current through QD_2, I_2, is too small to measure at the real-time charge sensing condition, we estimate the lever-arm factor of the side-gate voltage V_{SG2L} to μ_{QD2} from the charge sensing measurement of QD_2. Figures S1(a) to (c) show the current through QD_1, I_1, as a function of side-gate voltages V_{SG1} and V_{SG2L} at different source and drain bias voltages across QD_2, V_{SD2}. The gate voltage conditions are slightly changed from those in Fig. 3(a) supposedly because of the charge redistribution around the QDs. The Coulomb peak resonance in QD_2 appears at the shift of the I_1 Coulomb peak as indicated by the red arrows. As V_{SD2} decreases, the V_{SG2L} value of the QD_2 resonance decreases without significant broadening of the resonance. This indicates that the source electrode has larger tunnel coupling with QD_2 than the drain electrode, and that electron tunnelling occurs dominantly between QD_2 and the source electrode. Note that V_{SG1} is slightly increased with decreasing V_{SD2} to tune the chemical potential of QD_1, which hardly changes μ_{QD2}. Figure S2 shows the V_{SG2L} value for the QD_2 resonance as a function of V_{SD2}. From a linear fit to this data, we estimate the lever-arm factor of V_{SG2L} to μ_{QD2} to be 21 ± 1 meV/V by assuming that the source and the drain electrode have almost the same capacitance with QD_2.

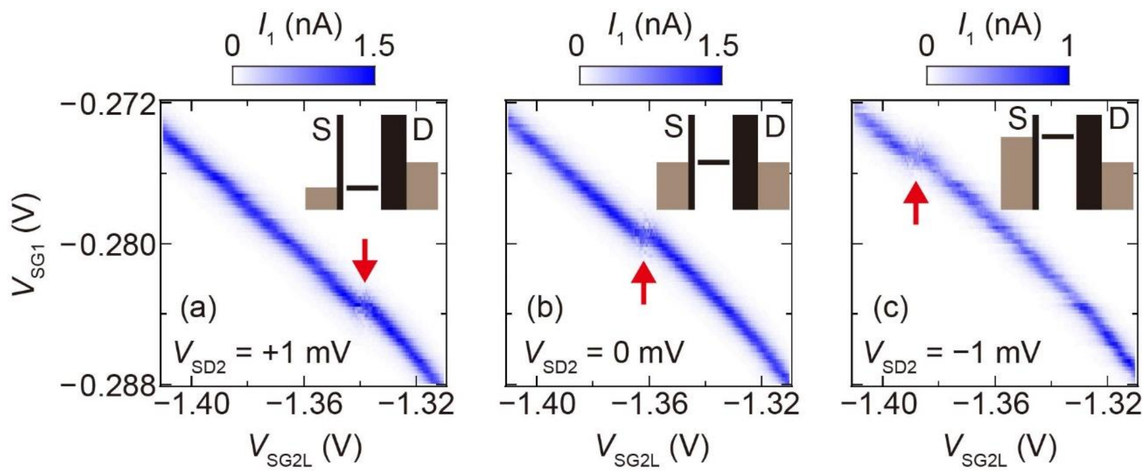

Figure S1. Intensity plot of I_1 in sample B as a function of $V_{SG1} = V_{SG1L} = V_{SG1R}$ and V_{SG2L} at (a) V_{SD2} = +1 mV, (b) V_{SD2} = 0 mV, and (c) V_{SD2} = −1 mV. The back-gate voltage is V_{BG} = −0.5 V, and the source and drain bias voltage across QD_1 is V_{SD1} = 70 μV. Insets schematically illustrate the energy diagram at the Coulomb peak resonance in QD_2 for each V_{SD2}.

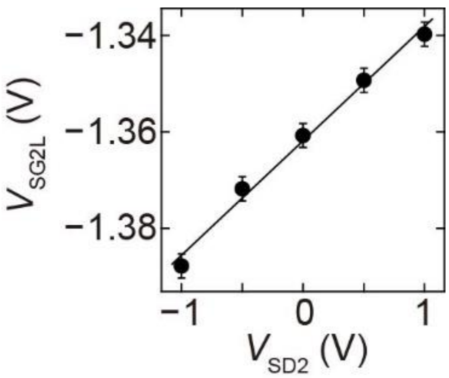

Figure S2. V_{SG2L} values for the QD_2 resonance as a function of V_{SD2}. The solid line represents a linear fit to the data.