Supporting Information

Highly Transparent Contacts to the 1D Hole Gas in Ultra-Scaled Ge/Si Core/Shell Nanowires

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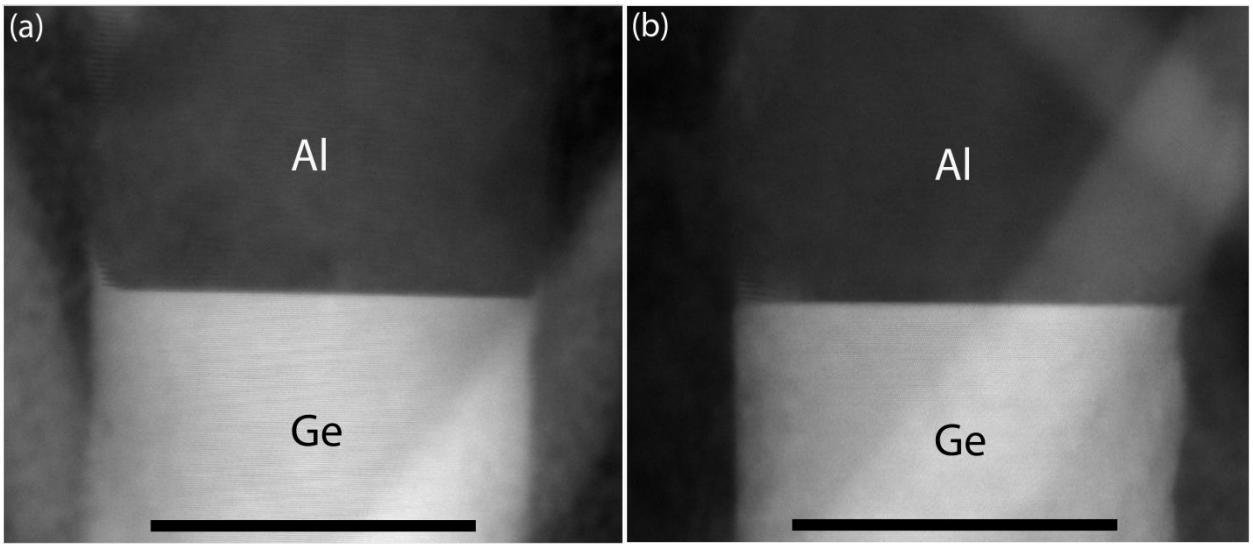
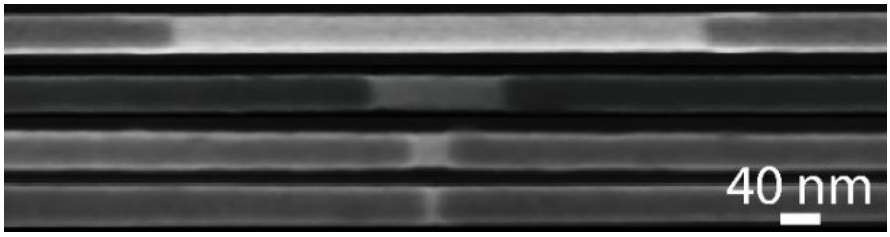
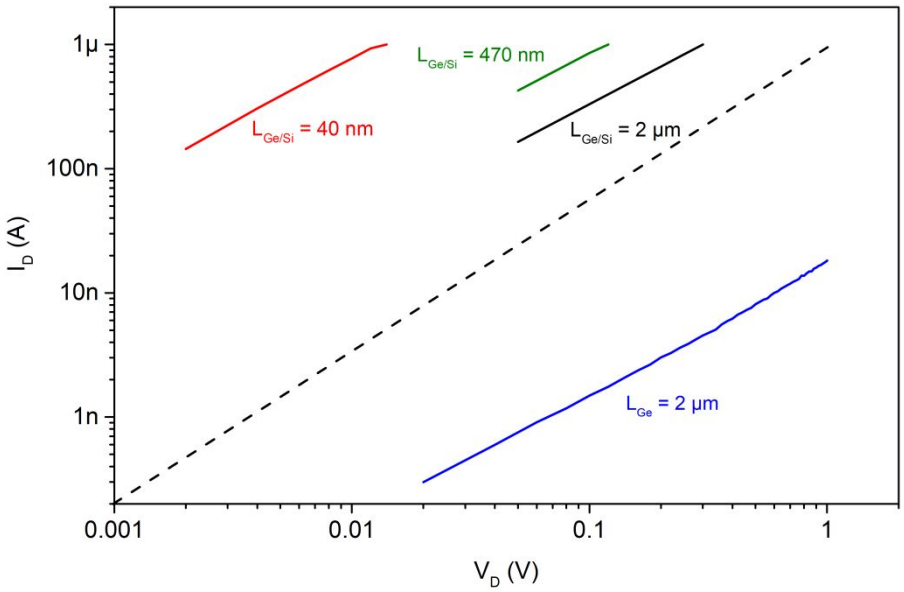


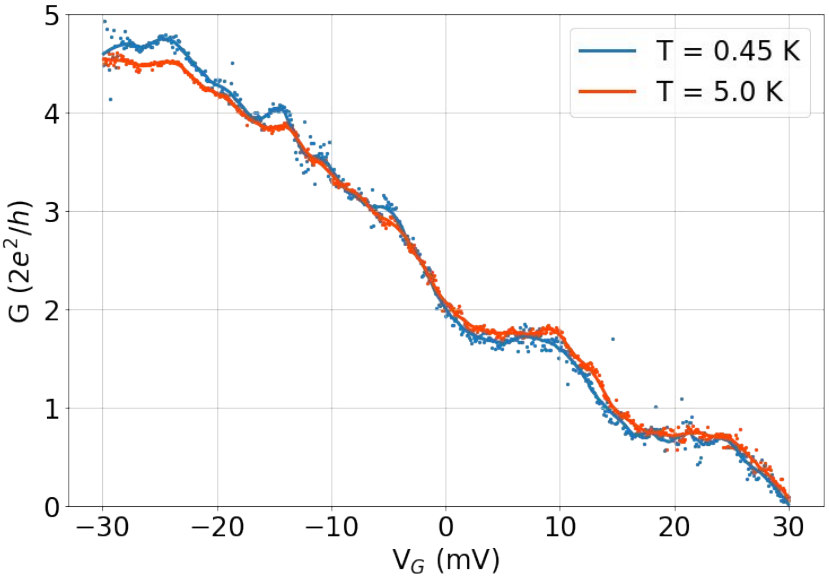
Supporting Figure S1: *STEM images of the same NW viewed under different angles. In the left pane the Ge region (bright contrast) is oriented close to a [110] direction of observation for the Ge crystal. The interface is flat over the NW radius. In the right pane the Ge region extends on the converted Al region mostly on the left side of the NW. The right pane is obtained on the [211] axis of the Al crystal. Going from the left to the right pane the NW is rotated by 36° around the NW axis. The scale bars are 50 nm.*



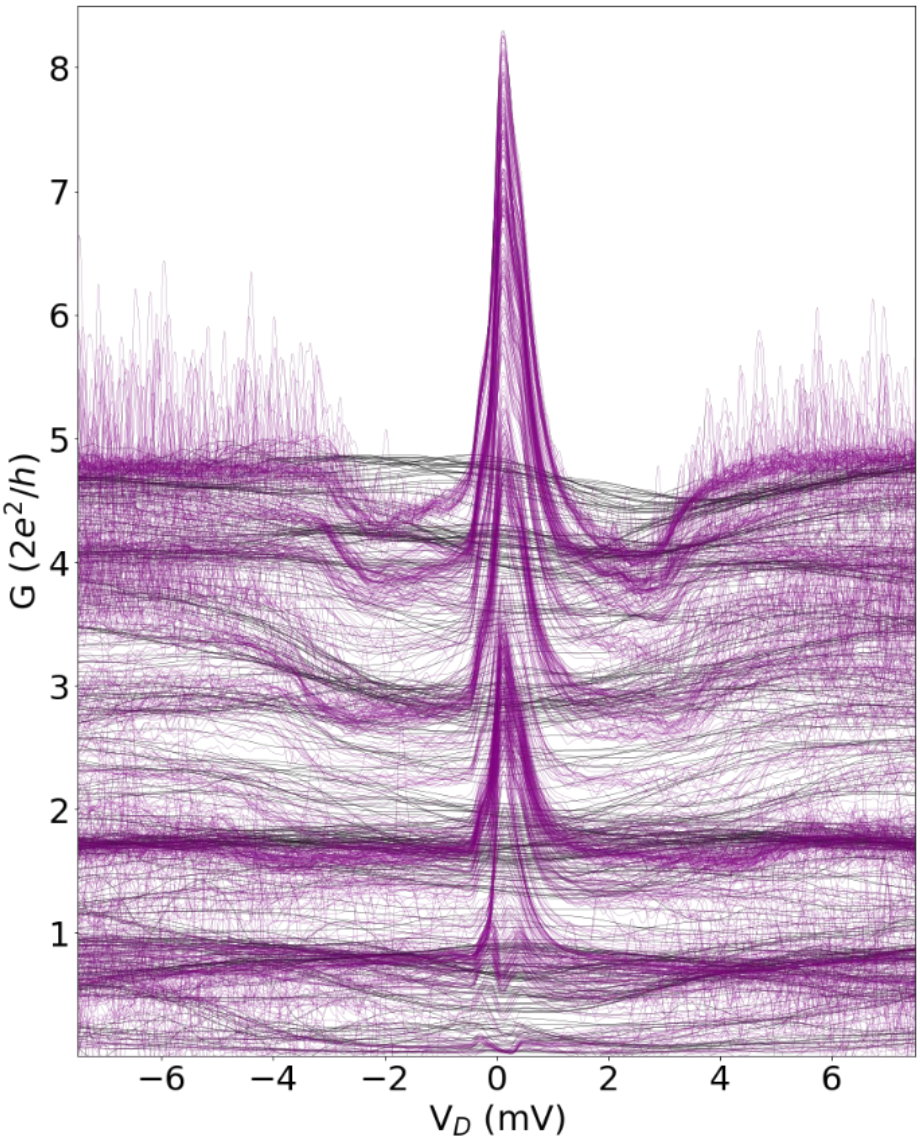
Supporting Figure S2: *Compilation of SEM images showing Al-Ge/Si-Al core-shell NW heterostructures with channel lengths of* $L_{Ge/Si}$ *= 540 nm, 125 nm, 40 nm and 10 nm.*



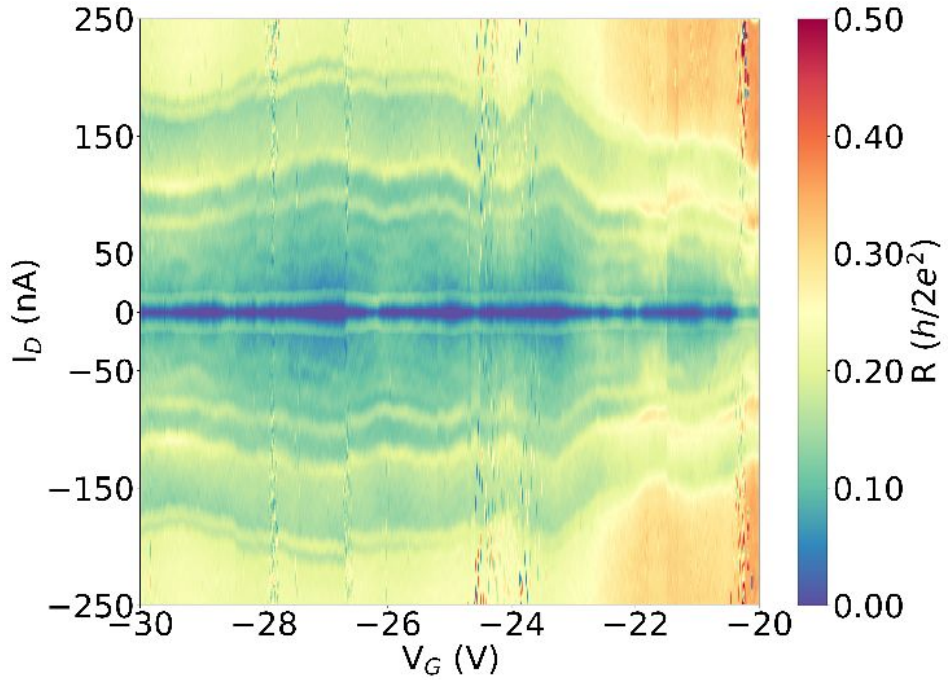
Supporting Figure S3: *Comparison of the I/V characteristic of an intrinsic Ge NW (blue), a Ge/Si core/shell NW (black) and Al-Ge/Si-Al heterostructure device with varying channel lengths of* $L_{Ge/Si}$ *= 470 nm (green) and* $L_{Ge/Si}$ *= 40 nm (red) achieved by consecutive annealing steps. The dashed line indicates a linear I/V relationship.*



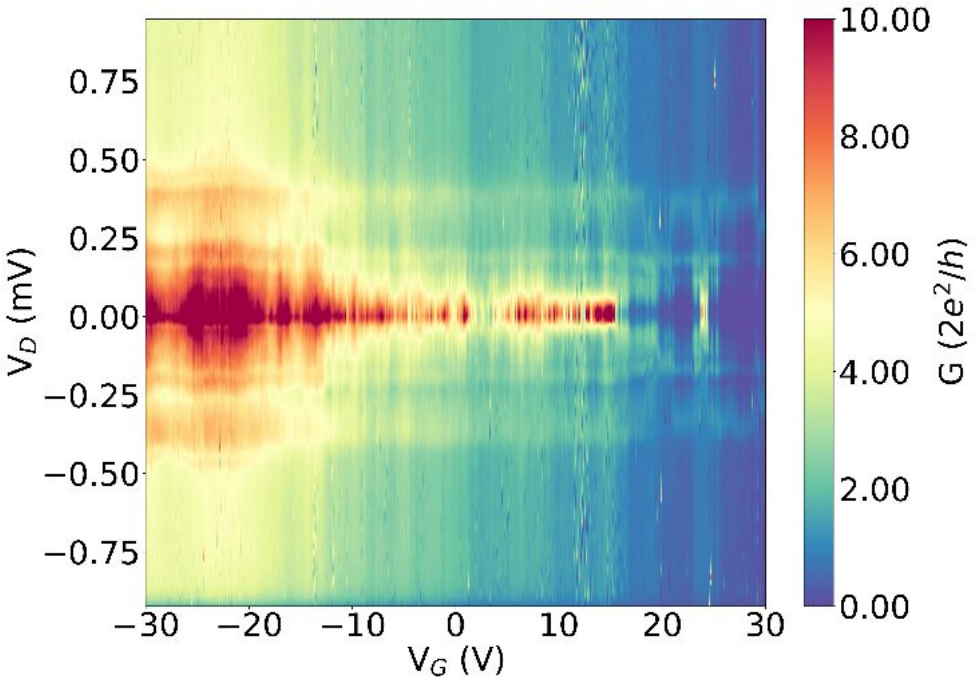
Supporting Figure S4: G–V_G characteristic curves of the Al-Ge/Si-Al heterostructure device measured in the pumped ^{3}He set-up at T = 0.45 K and T = 0.5 K. The curves were extracted from the G (V_D,V_G) measurements by taking an average of V_D slices of G (V_D,V_G) in the rage 4.95 mV < V_D < 5.05 mV, scatter plot. The average interface transparency of each conduction channel is approximately 86%. To smooth the data a Savitztky-Golvay filter is applied (solid curve). In this measurement, V_G was swept from 30 V to -30 V.



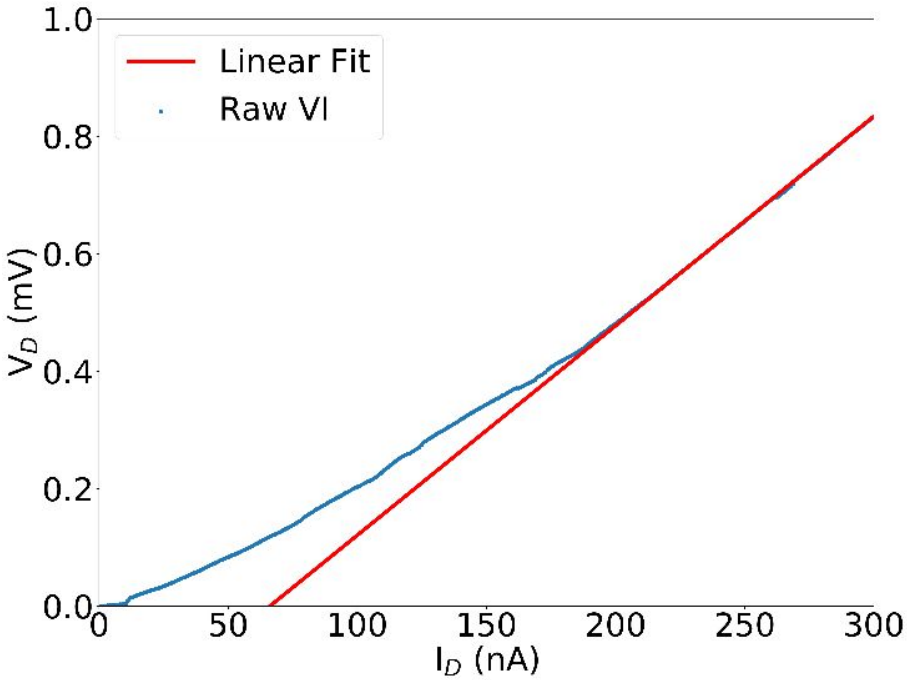
Supporting Figure S5: *$G = I_D / V_D$, with series resistance of 420 Ω subtracted, waterfall plot from V_G = 30 V to V_G = -30 V in 167 μV steps at T = 450 mK (purple) superimposed on waterfall plot from V_G = 30 V to V_G = -30 V in 334 μV steps at T = 2 K (black).*



Supporting Figure S6: *Differential resistance dV_D/dI_D, with series resistance of 420 Ω subtracted, plotted in units of the quantum resistance versus I_D and V_G for sweeping I_D from negative to positive and V_G from -20 V to -30 V measured at T = 450 mK. The dark blue regions correspond to zero resistance and indicate superconductivity induced into the Ge-Si core-shell channel. The symmetric MARs are visible as dips in resistance.*



Supporting Figure S7: *Differential conductance dI_D / dV_D at T = 420 mK plotted in units of quantum resistance versus V_D and V_G for sweeping V_D from negative to positive and sweeping V_G from 30 V to -30 V. The MARs are visible as peaks in conductance. The V_D values of the MARs are stable through 60 V of gate tuning.*



Supporting Figure S8: *Raw V/I curve at V_G = -29 V measured at T = 420 mK and linear fit of normal regime of V/I curve ($V_D > 2\,\Delta/e$) from which R_n and I_{exc} is determined. R_n = 3.6 kΩ is the gradient of linear fit and I_{exc} = 66 nA is the x-axis intercept.*