Supporting Information

The Mechanism of Modulation of Electronic Anisotropy in Two-dimensional ReS$_2$

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Figure S1. The optical images and polarized optical images of as-synthesized ReS$_2$, scale bar is 10 μm.
**Figure S2.** The atomic force microscope image of ReS$_2$ device.
**Figure S3.** Temperature dependent I-V curves at 0° and 90° directions at V<sub>g</sub> of 20 V, respectively.
Figure S4. Angle dependent mobility ratio mapping of ReS$_2$. 
Figure S5. Temperature dependent transfer characteristic curves at 0° and 90° directions, respectively.
Figure S6. (a) the $V_{th}$ value under different temperatures at both directions. (b) Temperature-induced doping concentration at both directions. Temperature-induced doping concentration can also be extracted by the parallel-plate capacitor model where $\Delta V$ is change of $V_{th}$ induced by temperature. Taken 100 K as initial point, thus the temperature-induced doping concentration is: $P_{2D}=(C_{ox}\Delta V_{th})/e$, Where $\Delta V_{th} = |V_{th}(T) - V_{th}(100K)|.$
Figure S7. X-ray photoelectron spectroscopy of as-grown ReS$_2$ on silicon substrate. (a) XPS full spectrum and (b) the high-resolution XPS Re 4f, (c) S 2p spectra.

<table>
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<th>Atom</th>
<th>Peak Area (Re 4f 7/2)</th>
<th>Peak Area (Re 4f 5/2)</th>
<th>Peak Area (S 2p 3/2)</th>
<th>Peak Area (S 2p 1/2)</th>
<th>Peak Area (S 1s)</th>
<th>Sensitivity</th>
<th>Atom component</th>
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<tr>
<td>Re</td>
<td>1473.947</td>
<td>936.713</td>
<td>2410.66</td>
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<td></td>
<td>1.89</td>
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<tr>
<td>S</td>
<td>587.836</td>
<td>129.209</td>
<td>717.04</td>
<td>0.49</td>
<td>0.89</td>
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The Schottky barriers are induced and investigated according to thermionic I-V relationship given as below:

\[
I_{ds} = AA^* T^2 \exp \left( \frac{q \Phi}{k_B T} \right) \left[ 1 - \exp \left( - \frac{q V_{ds}}{k_B T} \right) \right]
\]

Where A is junction area, A* is the Richardson constant, q is the magnitude of the electron charge and \( \Phi \) is the Schottky barrier. The Arrhenius plot of ReS\(_2\) device measured at various gate voltages is shown in Figure S8a. When \( T > 180K \), from the slope of \( \ln \left( \frac{I_{ds}}{T^2} \right) \) vs. 1000/T,
we calculated the Schottky barrier height (SBH) under different gate voltages. With the voltage increased from 0 to 20 V, the SBH at both directions reduces ~ 60 meV owing to increasing density of states in Fermi level (Figure S8b). But we note that a near linear change of SBH in b axis occurs while in cross b direction SBH shows an exponent decrease mode.\textsuperscript{2,3} To eliminate influence of variable SBH during modulation process, the anisotropic mobility under different gate voltages without SBH can be extracted based on effective bias voltages ($V_{\text{effective}}=V_{\text{load}}-\text{SBH}$). The anisotropic mobility ratio with and without SBH are shown in Figure S8c.

REFERENCES

