Observation of Reverse Drain-Induced Barrier Lowering and Emerging Negative Differential Resistance in Ambipolar WSe_2 Multilayers

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As the scaling of silicon-based semiconductor devices progresses, the resulting reduction in thickness worsens intrinsic limitations such as surface roughness, the formation of dangling bonds, and Coulomb scattering, ultimately hindering device performance. Addressing these challenges often necessitates complex fabrication processes and high production costs. As a potential alternative, two-dimensional (2D) van der Waals (vdW) materials have emerged as promising candidates owing to their chemically inert surfaces, absence of dangling bonds, tunable band gaps, and remarkably high exciton binding energies, offering viable solutions for next-generation electronic devices. In this poster, field-effect transistors (FETs) based on homojunction WSe_2 multilayers were fabricated to investigate the distinctive carrier transport characteristics. The reverse drain-induced barrier lowering (r-DIBL) effects were systematically analyzed as a function of electrostatic gate voltage, revealing a distinctive threshold voltage modulation. Furthermore, an emerging negative differential resistance (NDR) phenomenon was observed in homojunction devices without heterostructure interfaces.
These findings unveil the unconventional carrier transport mechanisms in ambipolar WSe_2 multilayers, providing profound insights into the design of high-performance 2D electronic devices and the development of next-generation device architectures.

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References

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[2] M. Cheong et al., ACS Appl. Electron. Mater. (2024) pp. 8532–8539

Figures

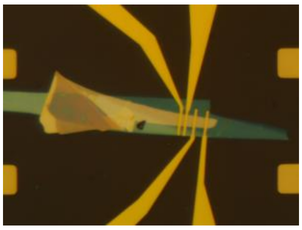

Figure 1: Device structure of a 2D WSe_2/h-BN

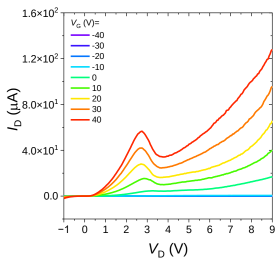

Figure 2: Presence of the negative differential resistance characteristic in output (I_D–V_D) curves