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Graphene-based Interlayer Tunneling Field-Effect Transistors: Device Physics and Applications

Graphene has attracted significant research interest in the past decade, and spearheaded a larger effort on other two-dimensional (2D) materials and their van der Waals heterostructures. Motivating in part this effort is the interest in emerging devices, which may augment functionalities of existing technologies. We discuss here the realization and device physics of graphene- and transition metal dichalcogenide-based interlayer tunneling field-effect transistors, a new class of devices that operate via energy and momentum conserving (resonant) tunneling between two 2D layers (Figure 1). We examine the case of double bilayer graphene heterostructures [1] separated by hexagonal boron-nitride [2,3] or WSe_2 [4], which show gate-tunable resonant tunneling when the two layers are rotationally aligned. In devices where the two graphene bilayers are separated by WSe_2, the interlayer current voltage characteristics show room temperature negative differential resistance with large peak-to-valley ratios, and high current densities. We discuss intrinsic benchmarks and potential applications.

References

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Figures

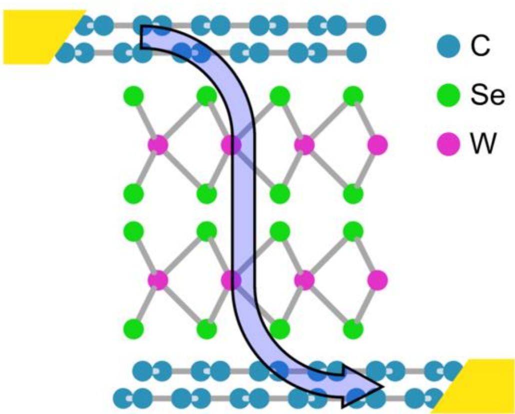

Figure 1: Schematic representation of an interlayer tunneling field-effect transistor consisting of two bilayer graphene separated by WSe_2.