Electrical Control of Valley-Zeeman Spin-Orbit-Coupling–Induced Spin Precession

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The extraordinary electronic properties of graphene can be controlled by stacking it with other layered materials creating van der Waals heterostructures. In particular, graphene's low spin-orbit coupling (SOC) can be enhanced by proximity with transition metal dichalcogenides (TMDs), leading to new spin transport channels with unprecedented spin textures [1-5]. We have optimized bilayer graphene-TMD heterostructures to achieve magnetic-field-free spin precession. Additionally, by applying a drift current, we have reversed the sign of the spin signal [8]. Our unprecedented observations represent the first realization of electrical control of SOC-induced spin precession at room temperature, a crucial requirement for spin-based logic operations that can enable a new generation of multifunctional spintronic devices.

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FIGURES

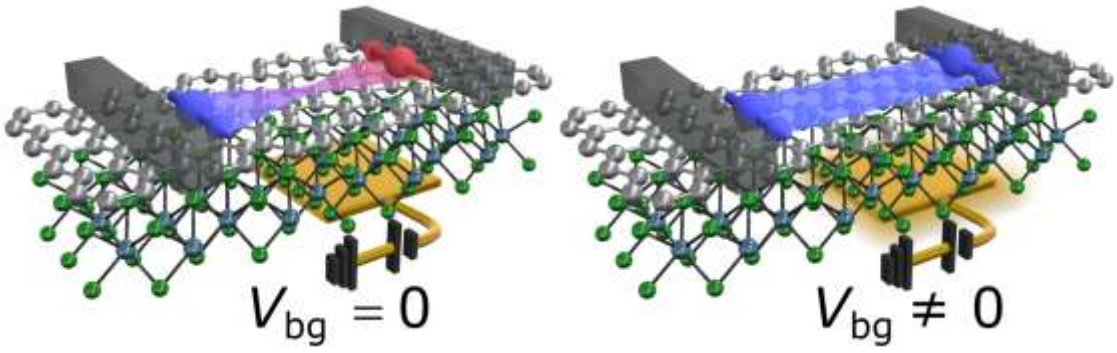

Figure 1: Schematic illustration of the device operation. At zero gate voltage (V_{bg}), the spins are reversed (left panel), whereas at nonzero V_{bg} spins are not reversed (right panel).