Spin and Valley Filter Based on Two-Dimensional WSe_2 Heterostructures

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In this work we investigate the possibility of inducing and controlling spin and valley polarizations on different potential profiles of two-dimensional tungsten diselenide (WSe_2) heterostructures. We study the case of single and double-potential barrier configurations. We focus on the resonant regime and how this effect allows the spin and valley polarizations. Exchange valley splitting is provided by the magnetic proximity effect, with the advantages that the splitting is dictated by the exchange interaction strength and that no applied magnetic field is required. This allows a convenient scenario for obtaining the tuning processes. Moreover, due to the versatility of being either positive or negative valued, this description opens up the possibility of tuning the valley splitting sign and magnitude together.

Furthermore, we analyze the possibility of promoting valley and spin polarization inversions on transition metal dichalcogenides (TMDC) layers under the effects of time-dependent external potentials, such as time-oscillating gate voltages or laser irradiation. Different mechanisms are analyzed to synchronize the physical parameters of the proposed system, such as the Fermi energy, the frequency and amplitude of the time-dependent potential, and the external gate voltages, to optimize the time-dependent transport properties, such as the induced switching effects of the transport of the systems.

These results validate the proposal of double quantum well structures of WSe2 as candidates to provide spin- and valley-dependent transport within an optimal geometrical parameter regime [1].

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References

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