Proximity Induced Spin-Orbit Coupling in Phosphorene on WSe_2 Monolayer

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Abstract. Van der Waals proximity effect in two-dimensional heterostructures represents a novel approach to modifying the electronic, optical, magnetic, and spin properties of the materials. Focusing on the heterostructure made of phosphorene and WSe_2 monolayer, we investigate the transfer of spin-orbit coupling from WSe_2 monolayer to phosphorene, via the proximity effect. Based on the symmetry of the heterostructure, we derive an effective spin Hamiltonian model for phosphorene and map it to the data obtained using the ab-initio calculation. We show that the created spin-orbit field is a combination of the in-plane field, present due to broken horizontal mirror plane symmetry, and the out-of-plane field, triggered by breaking the out-of-plane rotational symmetry of the phosphorene monolayer. Finally, we argue that the twist angle can be used to control and modify the spin-orbit proximity effect in this heterostructure.

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