Patterned Electrostatic Superlattices for Engineering Properties of Transition Metal Dichalcogenides Structures

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The properties of semiconducting Transition Metal Dichalcogenides (TMD) can be tailored by the presence of periodic potentials, offering a pathway to engineer novel quantum phenomena [1-2]. Most commonly, a super period is imposed via a moiré potential, as a result of twisting 2D layers However, this route is restricted in modifying the symmetry of the super potential as well as its strength, such parameters being determined by the nature of the twisted layers. An alternative route to twisting 2D materials in order to obtain superpotentials is to artificially create them electrostatically [1-3]

Here, we explore this avenue and aim to fabricate and characterize devices where the TMD layers are placed in an electrostatic potential. We first perform simulations of the electrostatic environment created by patterns of different symmetries and sizes using the finite element analysis software COMSOL Multiphysics. We explore nanofabrication lithographic and etching techniques to define patterns in the SiO2 gate dielectric and discuss our progress in pushing the boundaries of the size of artificial superpotential.

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