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First-principles study on quantum valley Hall effects in silicene
YOUNGKUK KIM, Department of Physics and Astronomy, Seoul National University, Seoul 151-747, Republic of Korea, HOSUB JIN, Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208, USA, KEUNSU CHOI, JISOON IHM, Department of Physics and Astronomy, Seoul National University, Seoul 151-747, Republic of Korea — Silicene is a two-dimensional honeycomb lattice of silicon atoms, similar to graphene. Based on first-principles calculations, we suggest that silicene is an ideal host for realization of quantum valley Hall effects. We show that the intrinsic buckled structure allows the formation of topological domain walls in silicene under a uniform applied electric field and valley-polarized kink states emerge on the domain walls. Peculiar behaviors of the kink states under various applied electric fields are demonstrated, and simulated scanning tunneling microscopy images are presented to show that they can be used to identify the topological domain walls as well as valley-polarized kink states. Our findings suggest that the one-dimensional domain wall may be used as an electrical wire through which valley-polarized current can flow, and silicene can be used as a valley polarizer.

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