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Optical imaging of the valley Hall effect in MoS_2 transistors

JIEUN LEE, Penn State University

The newly emerged two-dimensional (2D) transition metal dichalcogenides (TMDs) with nonequivalent K and K' valleys have provided an ideal laboratory for exploring the valley degree of freedom of electrons, as well as their potential applications for information processing. Valley Hall effect (VHE), in which a transverse valley current is formed under a longitudinal electrical bias in the absence of a magnetic field, has been predicted in 2D TMDs with broken inversion symmetry. The effect has recently been demonstrated in monolayer MoS_2 through a photo-induced anomalous Hall effect, which uses circularly polarized light to preferentially excite electrons into a specific valley. In this talk, we will present our recent results on the development of Kerr rotation microscopy to image the VHE. The valley polarizations of opposite sign accumulated on two opposing edges of MoS_2 transistors from the VHE are measured directly. We will also discuss the possibility of electrical control of the VHE in bilayer MoS_2, which possesses inversion symmetry. An application of a vertical electric field breaks the inversion symmetry and consequently yields the VHE.