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Spin-valley coupling study in transition metal dichalcogenides LU XIE, the University of Hong Kong — A single layer (monolayer) of transition metal dichalcogenide (TMD), a two dimensional (2D) crystal with a Honeycomb lattice structure, has attracted tremendous interests thanks to its unique optical and electronic properties. Unlike graphene, TMD monolayer is a direct-gap semiconductor with interband transition in the visible energy range. The direct gap is located at the corners of the 2D hexagonal Brillouin zone which are technically called valleys. The two degenerate but inequivalent valleys (denoted by ±K) constitute a binary degree of freedom, which is potentially treated as a new kind of information carrier just like the traditional charges and spin. In TMD monolayer, the inversion symmetry is originally broken. This leads to valley-selective circular dichroism meaning that the ± K valleys can only be exclusively excited by right-($\sigma+$) or left-circularly (σ-) polarized light, which enables optical manipulation of the valley pseudospin. Besides, the strong spin-orbital coupling (SOC) mainly stemming from the transition metal atoms gives a remarkable valence band spin splitting ranging from 0.1 eV to 0.5 eV for different TMDs. Together with the above mentioned inversion symmetry breaking, this leads to strong coupled spin and valley which makes the valley and spin robust against scattering by smooth deformations and long wavelength phonons. As a result, the valley-dependent optical selection rule is often accompanied by a spin-dependent optical selection rule. Here, we will present the experimental demonstration of the spin-valley locking in TMD monolayer. The spin polarization is realized by the circular polarized optical fields and is electrically detected.

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