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Ultrafast generation of pseudo-magnetic field for valley excitons in WSe2 monolayers JONGHWAN KIM, XIAOPING HONG, CHENHAO JIN, SU-FEI SHI, Univ of California - Berkeley, CHIH-YUAN S. CHANG, Academia Sinica, MING-HUI CHIU, LAIN-JONG LI, King Abdullah University of Science, FENG WANG, Univ of California - Berkeley — The valley pseudospin emerges as a new degree of freedom in atomically thin two-dimensional transition metal dichalcogenides (MX2). In analogy to the control of spin in spintronics, the capability to manipulate the valley pseudospin can provide exciting opportunities in valleytronics. Here we present that femtosecond pulses with circular polarization can generate ultrafast and ultrahigh valley pseudomagnetic field in a monolayer MX2. Our polarization-resolved transient absorption measurement shows that the degeneracy of valley exciton transitions at K and K' valley in WSe2 monolayers can be lifted by optical Stark effect from the non-resonant pump. Energy splitting due to the optical Stark effect is linear with both the pump intensity and the inverse of pump detuning. We observe that valley-selective optical Stark effect can create an energy splitting more than 10 meV which corresponds to a pseudomagnetic field over 60 Tesla. Our study demonstrates efficient and ultrafast control of the valley excitons with optical light which can open up the possibility of coherent manipulation of the valley polarization in MX2.

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