Ultrafast exciton dynamics in WSe_2 optical waveguides

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We investigated dynamics of excitons in a Van der Waals Semiconducting, WSe_2, waveguide. We monitored the electric-field profile of waveguided infrared radiation under intense femtosecond photo-excitation in real space and time. Drastic modifications of the complex wavevector of guided radiation were observed. The non-equilibrium energy momentum dispersion relationship implicates excitons in the photo-induced transformations. Unprecedented coherent dynamics of refraction, on the sub-ps timescale, reveal an optical stark-shift of the A-exciton resonance. Our study establishes that excitons enhance the performance of vdW optical modulators providing a tuning knob unavailable in conventional III-V semiconducting platforms. Our transient images and first-principles theoretical calculations establish fundamental limits of excitons in WSe_2optical modulators.

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