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Ultrafast valley depolarization dynamics in monolayer transition metal dichalcogenides STEFANO DAL CONTE, FEDERICO BOTTEGONI, EVA POGNA, Politecnico di Milano, DOMENICO DE FAZIO, Cambridge Graphene Centre, University of Cambridge, FRANCO CICCACCI, Politecnico di Milano, ANDREA FERRARI, Cambridge Graphene Centre, University of Cambridge, GIULIO CERULLO, MARCO FINAZZI, Politecnico di Milano — The ability to control the valley degrees of freedom is the foundation of the emerging field of valleytronics. Atomically thin transition metal dichalcogenides, thanks to the interplay between the spin and the momentum of the carriers, are a promising platform for the implementation of new devices exploiting the valley and spin degrees of freedom. Here, we measure the exciton valley relaxation dynamics in monolayer MoS_2 by time-resolved Faraday rotation. We find that the temporal evolution of the Faraday angle has a double exponential decay, showing that the intervalley scattering of the photogenerated excitons is extremely quick (˜200 fs). On a slower time scale, a residual component of the valley polarization, lasting few ps, is detected. This physical scenario is confirmed by time-resolved circular dichroism experiments where the transient variation of the transmission is measured by co- and counter-circularly polarized broadband pulses. The intervalley relaxation processes of other two dimensional semiconductors (i.e. WS_2) have been studied with the same techniques at different probe energies, close to the excitons and the trion resonances. We also investigate how the valley relaxation dynamics depends on the density of the photoexcited carriers and the energy of the excitation pulses.

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