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Spectrally narrow neutral and charged exciton emission in MoS2 monolayers : optical doping and superacid treatment GANG WANG, FABIAN CADIZ, CEDRIC ROBERT, SIMON TRICCARD, MARCO MANCA, DELPHINE LAGARDE, PIERRE RENUCCI, THIERRY AMAND, XAVIER MARIE, CNRS - Toulouse University, SEFAATTIN TONGAY, Arizona State University, BERNHARD URBASZEK, CNRS - Toulouse University — In MoSe2 and WSe2 Monolayers (MLs) photoluminescence (PL) at low temperatures normally exhibits narrow neutral exciton (X) and trion (T) lines (FWHM 10 meV). In contrast, in MoS2 MLs only a single broad peak is observed (FWHM 50 meV) which has been attributed to a possible mixture of X and T emission. This peak is accompanied by a low energy emission attributed to defect-related transitions. Here we present results on MoS2 MLs treated by an inorganic superacid (TFSI) that has been previously shown to passivate defects. In these treated MLs, well identified X and T peaks dominate the optical spectrum at T=4K. Due to the clear X-T separation, we were able to initialize neutral exciton valley coherence (superposition of valley states) with linearly polarized excitation. In addition, we show that at very low laser excitation powers, the X and T peaks can be well identified in MLs even in the absence of any acid treatment, in contrast to what is usually found in the literature. A detailed investigation of the PL as a function of excitation power reveals a non-reversible change in the PL spectrum caused by laser exposure, at power densities that so far have been considered to be non-destructive.

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