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Temperature and polarization dependence of photoluminescence in monolayer tungsten diselenide JIANI HUANG, THANG HOANG, MAIKEN MIKKELSEN, Department of Physics, Duke University — Two-dimensional transition metal dichalcogenides (TMDCs) have recently attracted considerable research interest, due to their wide direct band-gaps, strong spin-orbit couplings and inversion symmetry breaking when compared to graphene. These properties have rich physics and applications in electronics, optics and spintronics. Here, we experimentally study the evolution of photoluminescence (PL) from mechanically exfoliated monolayer tungsten diselenide (WSe_2) from $T = 10$ K to room temperature. At $T = 10$ K, we observe a clear free exciton (X^0) emission at 1.75 eV together with a charged trion emission at 1.72 eV, yielding a trion binding energy of 30 meV. Temperature dependent PL measurements show that both the free exciton and trion exist up to room temperature, as a result of the large exciton ($\sim$370 meV) and trion binding energies of WSe_2, while other localized and defect-related emission peaks vanish above $T = 65$ K. Temperature dependent polarization of the exciton and trion emisisons reveal a combined effect of large exciton binding energy, anisotropic thermal expansion and exciton-phonon interaction. These findings may provide a new platform to explore the valley polarization and valley-spin coupling in monolayer TMDCs.

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