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Temperature-dependent photoluminescence and Raman spectroscopy of single-layer MoS_2 J.R. SIMPSON, Towson University, R. YAN, Notre Dame, S. BERTOLAZZI, A. KIS, J. BRIVIO, EPFL, M. WATSON, Towson University, H.G. XING, Notre Dame, A.R. HIGHT WALKER, NIST — We report the temperature-dependent photoluminescence (PL) and Raman spectra of single-layer MoS_2. Mechanical exfoliation from bulk MoS_2 provides single-layer flakes which are then transferred to either sapphire (with and without ALD HfO_2 overcoating) or suspended over holes in a Si/Si_3N_4 substrate. We measure the temperature dependence of PL and Raman spectra from (100 to 400) K using HeNe 632.8 nm (PL) and Ar^+-ion 514.5 nm (Raman) laser excitations coupled to a microscope and grating spectrometer. PL shows a single, narrow peak corresponding to a direct-band transition approximately centered at 1.9 eV with a width of 50 meV. The PL peak redshifts and broadens with increasing temperature. Raman spectra reveal two strong phonon vibrational modes, the planar E^1_{2g} and out-of-plane A_{1g}, both of which soften linearly with increasing temperature as a result of anharmonic effects. We extract a linear temperature coefficient for both Raman modes comparable to the G-mode of graphene. A comparison with the dependence of phonon peak position on incident optical power for the suspended sample shows moderate heat flux efficiency. The impact of dielectric and substrate environment on extraction of thermal conductivity will be discussed.

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