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Identifying the Reason for Variations in Circularly Polarized Photoluminescence Values in Monolayer WS_2[1] KATHLEEN MCCREARY, MARC CURRIE, AUBREY HANBICKI, BEREND JONKER, Naval Research Laboratory — The unique electronic band structure in single layer WS_2 provides the ability to selectively populate a desired valley by exciting with circularly polarized light. The valley population is reflected through the circular polarization of photoluminescence (PL) and a high degree of circular polarization has been predicted in WS_2. Interestingly, experimental work has shown this is not always the case. In particular, recent experimental investigations of monolayer WS_2 find near zero valley polarized emission from the neutral exciton under near resonant excitation. We investigate the circularly polarized PL in over twenty WS_2 monolayer samples synthesized using chemical vapor deposition. The room temperature circularly polarized emission (P_{circ}) values vary from 0% to 20%. The samples also exhibit considerable variation in exciton lifetime, ranging from 300 ps to ˜1.5 ns, as measured by time resolved photoluminescence. Comparing P_{circ} with the exciton lifetimes (τ_r) reveals an inverse relation between the τ_r and circular polarization, with samples exhibiting the longest τ_r having the lowest P_{circ} and vice versa. Our findings suggest that 100% circular polarization will be achieved in samples exhibiting short τ_r.

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