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Strong Circularly Polarized Photoluminescence From Multilayer MoS_2 Through Plasma Driven Direct-Gap Transition ROHAN DHALL, University of Southern California, KYLE SEYLER, University of Washington, ZHEN LI, University of Southern California, DARSHANA WICKRAMARATNE, MAHESH NEUPANE, UC Riverside, IOANNIS CHATZAKIS, University of Southern California, EWA KOSMOWSKA, XEI Scientific, ROGER LAKE, UC Riverside, XIAODONG XU, University of Washington, STEPHEN CRONIN, University of Southern California — We report circularly polarized photoluminescence spectra taken from few layer MoS_2 after treatment with a remotely generated oxygen plasma. Here, the oxygen plasma decouples the individual layers in MoS_2 by perturbing the weak interlayer van der Waals forces without damaging the lattice structure. This decoupling causes a transition from an indirect to a direct band gap material, which causes a strong enhancement of the photoluminescence intensity. Furthermore, up to 80% circularly polarized photoluminescence is observed after plasma treatment of few layer MoS_2 flakes, consistent with high spin polarization of the optically excited carriers. A strong degree of polarization continues up to room temperature, further indicating that the quality of the crystal does not suffer degradation due to the oxygen plasma exposure. Our results show that the oxygen plasma treatment not only engineers the van der Waals separation in these TMDCs multilayer for enhanced PL quantum yields, but also produces high quality multilayer samples for strong circularly polarized emission, which offers the benefit of layer index as an additional degree of freedom, absent in monolayer MoS_2.

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