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Enhanced Photoluminescence and Photocurrent Spectra in MoS2 under Ionic Liquid Gating ZHEN LI, SHUN WEN CHANG, STEPHEN CRONIN, University of Southern California — We report substantial improvements in the photoluminescence (PL) and photocurrent (PC) spectra of monolayer MoS2 field effect transistors taken under electrostatic and ionic liquid gating conditions. The photocurrent and photoluminescence spectra show good agreement with a dominant peak at 1.9eV. The magnitude of the photoluminescence and photocurrent can be increased significantly by Si back gating and ionic liquid gating due to the passivation of surface states and trapped charges that act as recombination centers and cause non-radiative recombination of photoinduced electron-hole pairs. Under ionic liquid gating, we observe an increase in the photoluminescence intensity by 300%, while the linewidth decreases by 37%. The photocurrent also doubles when passivated by the ionic liquid. The acute sensitivity of monolayer MoS2 to ionic liquid gating and passivation arises because of its high surface-to-volume ratio, which makes it especially sensitive to trapped charge and surface states. Under high gating conditions, we observe a slight decrease in the photoluminescence intensity, most likely due to Auger recombination. These results reveal that, in order for efficient optoelectronic devices to be made from monolayer MoS2, some passivation strategies must be employed to mitigate the issues associated with surface states.

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