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Photoluminescence properties of WS_2 under optical irradiation

Two-dimensional transition metal dichalcogenides, like monolayer MoS_2 and WS_2, have been promising materials for on-chip light sources due to its direct-bandgap and convenient transfer characteristics [1]. Though these materials have more efficient optical gain and are easily integrated or transferred on various substrates, their photoluminescence properties can be influenced by ambient environment[2], different from Ⅲ-Ⅴ compound semiconductors. We show that the photoluminescence spectra of WS_2 are different on various substrates, and changes under continuous violet laser illumination. Because atmospheric moisture and oxygen adsorbed on WS_2 induce p-doping by chemical reaction [3], the densities of trions and neutral excitons have changed, resulting in the enhancement of photoluminescence intensity. However the monolayer WS_2 will be damaged by long-time laser irradiation. In order to extend the lifetime of WS_2, we coated it with Al_2O_3 to isolate air, and the stability was indeed improved. To design a commercial on-chip light sources, there are further studies required to do on these monolayer materials.

References

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Figures

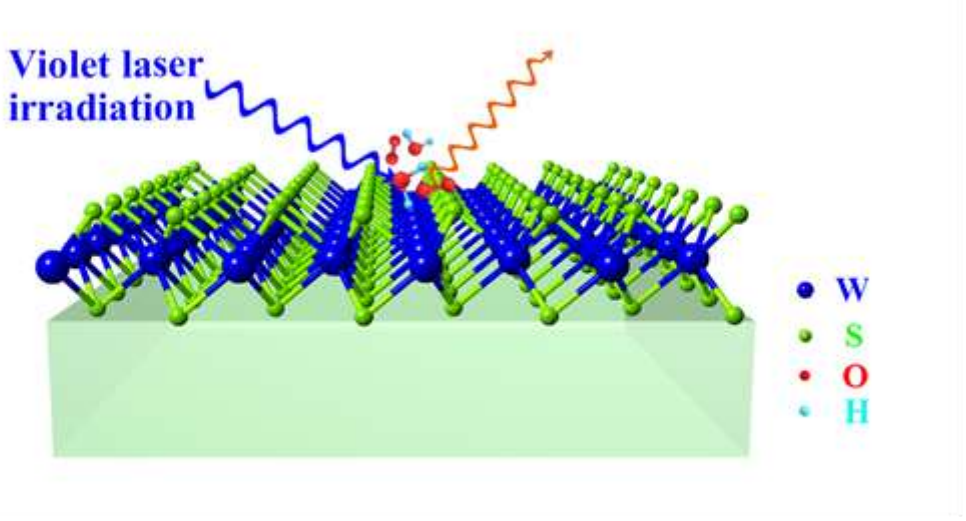

Figure 1: Schematic diagram illustrating light emission from monolayer WS_2 on substrate under violet laser irradiation