2D Edge Dependent local exciton on MoS_2

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Transition metal dichalcogenides (TMDCs) exhibit fascinating physics and have garnered significant attention due to their tunable exciton. Although recent advancements in edge-dependent exciton have been reported, achieving exciton tunning by different Mo/S ratios on edge remains a challenge. In this work, we successfully fabricate different Mo/S ratio edge structures on MoS_2, including circular (messy Mo/S ratio) and triangular (Mo/S = 4:1, 2:1, 1:1, 1:2, and 1:4) edges, using a Si_3N_4-protected focused ion beam (FIB) system. We demonstrate on triangle edge, a local exciton that experiences a redshift from the pristine 1.8 eV to 1.7 eV due to the high-order atomic arrangement, and exciton on the circle edge, present a blue shift to 1.9 eV, attributed to lower connection energy. Specifically, the exciton of triangular edge shows a significant intensity variation dependent on the Mo/S ratio, which the edge of Mo/S = 1: 4 present high intensity than other ratios. Furthermore, we find the triangular edge MoS2 devices exhibit enhanced photocurrent on-off switching behavior using a time-resolved photodetector. These findings open a new way to tunning exciton by designing edge structures, which increases the field of photoelectric device applications.

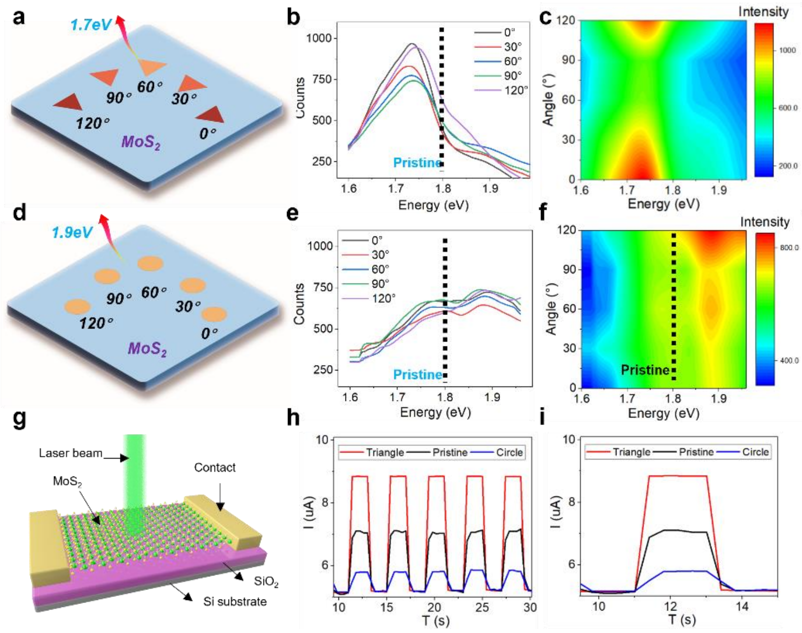

Figure. Edge angle and its PL properties. a) the schematic of triangle edge structure of 0, 30, 60, 90, and 120 degrees on MoS_2, the color of triangle present the intensity of 1.7 eV. b) the PL intensity of 0, 30, 60, 90, and 120 degrees, the black dashed line shows the pristine signal of 1.8 eV. c) the intensity mapping of 0, 30, 60, 90, and 120 degrees corresponding to b). d) the schematic of circle edge structure of 0, 30, 60, 90, and 120 degrees on MoS_2, the color of triangle present the intensity of 1.9 eV. e) the PL intensity of 0, 30, 60, 90, and 120 degrees, the black dashed line shows the pristine signal of 1.8 eV . f) the intensity mapping of 0, 30, 60, 90, and 120 degrees corresponding to e). g) the schematic of the device. h) Photocurrent on–off switching behavior in the MoS_2 device triangle-fabricated (red), circle-fabricated (blue), and with pristine (black). i) the photocurrent generation (τ_{rise}) and decay (τ_{decay}) times corresponding to h).

Bibliography

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