

Enhanced edge-nonlinear response and photoresponse in MoS₂ nanoribbons

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This work will present our findings on the growth of highly crystalline MoS₂ nanoribbons and multilayer triangular crystals with controlled stacking orientation. The synthesis method relies on the reaction between ultra-thin films of MoO₃ grown by Pulsed Laser Deposition and NaF in a sulfur-rich environment [1]. The MoS₂ nanoribbons can reach up to 10 μm in length and 500 nm in width, resulting in a high aspect ratio. Atomic Force Microscopy (AFM) and Tip-enhanced photoluminescence (TEPL) spectroscopy reveal that the MoS₂ nanoribbons feature single-layer edges with blue-shifted exciton emission, forming a versatile single-multilayer homojunction. Multiphoton microscopy reveals a significant optical second harmonic generation (SHG) from the single-layer edges of the nanoribbons. We will discuss these findings based on the non-centrosymmetric single-layer edge and/or symmetry breaking at the surface. Moreover, we report on a high-performance single-nanoribbon MoS₂ photodetector with a remarkable responsivity of 7.59×10^2 A/W, superior to previously reported nanoribbon photodetectors.

References

- [1] D. I. Miakota, R. R. Unocic, F. Bertoldo, G. Ghimire, S. Engberg, D. Geohegan, K. S. Thygesen, and S. Canulescu, *Nanoscale* 14 (2022), 9485.
- [2] G. Ghimire, R. Kumar Ulaganathan, A. Tempez, O. Ilchenko, R. R. Unocic, J. Heske, D.I. Miakota, C. Xiang, M. Chaigneau, T. Booth, P. Bøggild, K. S. Thygesen, David B. Geohegan, and S. Canulescu, submitted (2023).

Figures

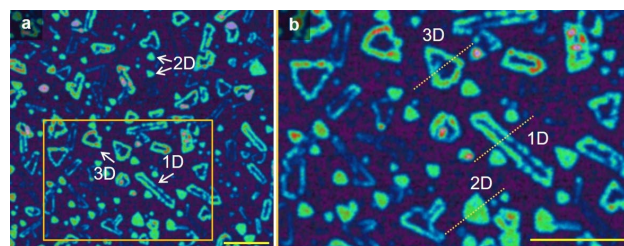


Figure 1: (a) SHG map of the MoS₂ nanostructures and (b) zoom over a selected area with edge-enhanced SHG.

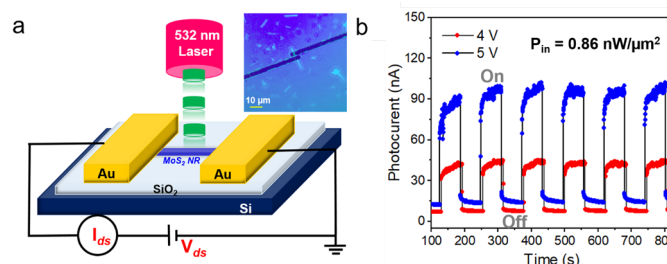


Figure 2: (a) Schematic of the MoS₂ nanoribbon device under 532 nm laser illumination and (b) ON/OFF photo response of the nanoribbon.