Abstract

Title: Lanthanide near-infrared luminescence in two-dimensional TMDs nanosheets

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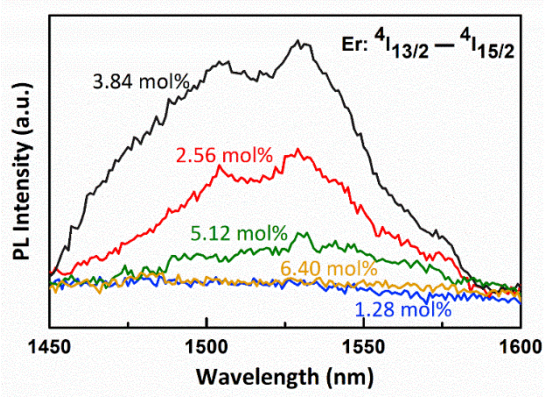
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I. Abstract Body

Lanthanide ions have been investigated extensively due to their superior luminescence properties. As the development of next-generation optoelectronics devices at 2D limit, tuning of the intrinsic luminescence of atomically thin semiconductors has attracted great research interest. This study investigated the near-infrared emission of lanthanide ions in transition metal dichalcogenides (TMDs) nanosheets both experimentally and theoretically. Under high chalcogenide concentration environment, single crystalline TMDs nanosheets were successfully obtained. The down-shifting emission from lanthanide dopant was observed under laser excitation. The photoluminescence of TMDs host was successfully extended to the NIR telecommunication range. To gain a theoretical insight into the energy transfer mechanism, the doped TMDs system was further investigated using first-principle calculation. By comparing the structural and electronic properties between pristine and lanthanide doped TMDs nanosheets, the stability of the lanthanide dopant in host matrix was verified. The location of lanthanide doping energy levels was predicted by combining the density of state (DOS) calculation results with the Dieke Diagram. The consistency between our theoretical calculation and experimental results provides an in-depth understanding of lanthanide doped TMDs nanosheets. This research is supported by the grant Research Grants Council of Hong Kong (GRF No. PolyU 153281/16P) and National Natural Science Foundation of China (NSFC No.51972279).

II. Image:



III. Reference:

1 Y. Lyu, Z. Wu, W.F. Io, J. Hao, 2019. Observation and theoretical analysis of near-infrared luminescence from CVD grown lanthanide Er doped monolayer MoS_2 triangles. *Appl. Phys. Lett.*, **115**, 153105.

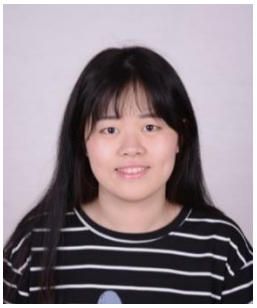
2. G. Bai, S. Yuan, Y. Zhao, Z. Yang, S.Y. Choi, Y. Chai, S.F. Yu, S.P. Lau, J. Hao, 2016. 2D layered materials of rare-earth Er-doped MoS_2 with NIR to NIR down- and up-conversion photoluminescence. *Adv. Mater.*, **28**, 7472.

3. G. Bai, Y. Lyu, Z. Wu, S. Xu, J. Hao, 2020. Lanthanide near-infrared emission and energy transfer in layer WS_2/MoS_2 heterostructure. *Sci. China Mater.*, **63**, 575-581.

IV. Biography:

Yongxin Lyu obtained her B.S. and M.Phil. in Department of Applied physics, the Hong Kong Polytechnic University. Her research interest mainly focuses on lanthanide doping of two-dimensional materials.

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