南方科技大学

优秀硕士学位论文申请材料

作者姓名：李岱岳

导师姓名：林君浩

学科/专业学位类别：理学

所在院系：理学院物理系

攻读硕士学位期间代表性成果

SCI 检索源期刊：

1. HOU F, ZHANG Y, LI D, et al. Deciphering the structure-photoluminescence correlation at small-tilt-angle grain boundaries in monolayer WS_2[J]. Applied Physics Letters, 2022, 121(5): 051104.（共同第一作者，SCI 收录，WOS:000835323500005，IF=3.971，对应学位论文 2.5.2 条）

导师对学生参评优秀硕士学位论文代表性成果的审查意见：

该生攻读硕士期间的代表性成果，数据准确无误、真实可靠，无学术不端和学术失范行为。

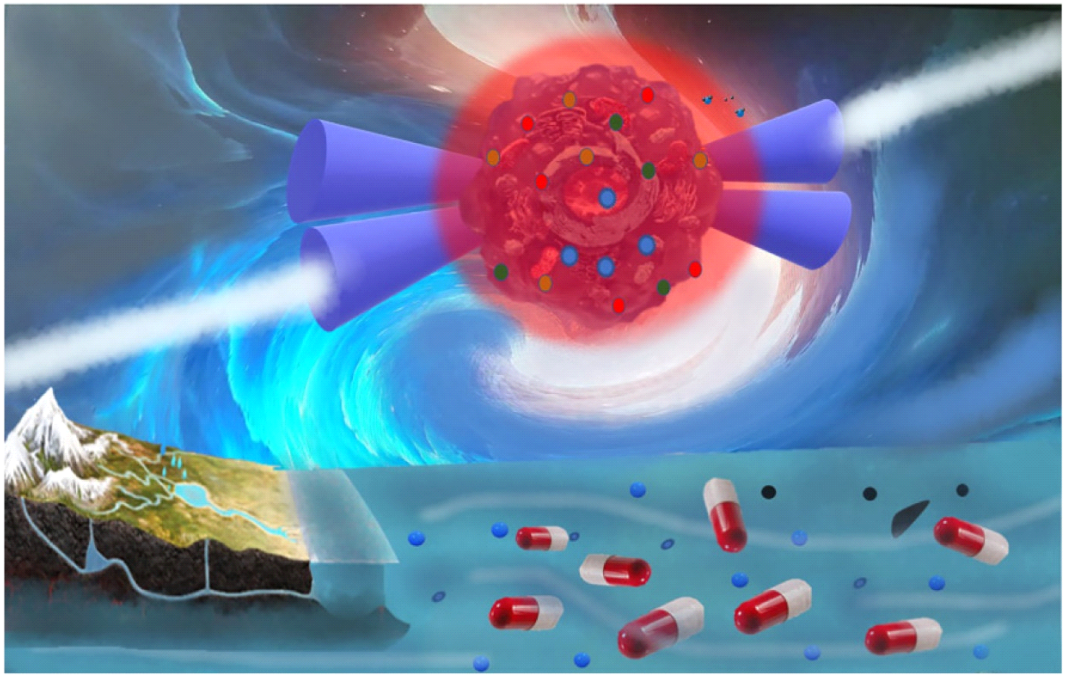
导师签字： 林君浩

日期： 2023.5.9

期刊封面

Applied Physics Letters

scitation.org/journal/apl



Volume 121, Issue 5, 1 Aug. 2022

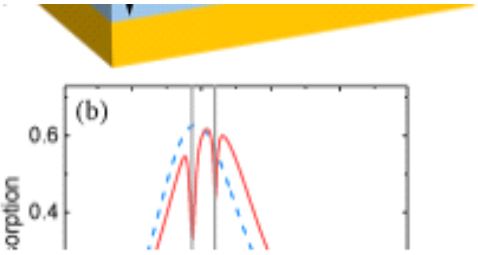
Low-concentration antibiotic detection in water based on enhanced photothermal effect

Appl. Phys. Lett. **121**, 051102 (2022); doi: 10.1063/5.0098034

Wenjuan Zhang, Yinping Miao, Hongmin Zhang, and Jianquan Yao

AIP Publishing

目录

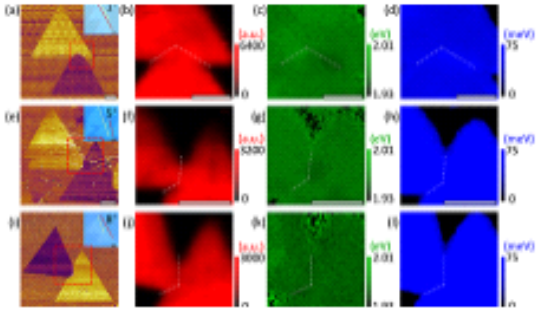


plasmons for mid-infrared photodetection and chemical sensing: A computational study

S. Doukas, P. Sharma, I. Goykhman and E. Lidorikis

Appl. Phys. Lett. **121**, 051103 (2022);
https://doi.org/10.1063/5.0093981

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION



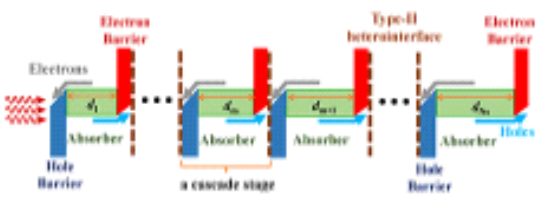
Full . August 2022

Deciphering the structure-photoluminescence correlation at small-tilt-angle grain boundaries in monolayer WS_2

Fuchen Hou, Yubo Zhang, Daiyue Li, Liangyu Che and Junhao Lin

Appl. Phys. Lett. **121**, 051104 (2022);
https://doi.org/10.1063/5.0097638

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION



Full . August 2022

Shot and Johnson noises in interband cascade infrared photodetectors

Rui Q. Yang

Applied Physics Letters ARTICLE scitation.org/journal/apl

Deciphering the structure-photoluminescence correlation at small-tilt-angle grain boundaries in monolayer WS_2

Cite as: Appl. Phys. Lett. **121**, 051104 (2022); doi: 10.1063/5.0097638
Submitted: 30 April 2022 · Accepted: 16 July 2022 ·
Published Online: 2 August 2022

Fuchen Hou,[1,2] Yubo Zhang,[1,3] Daiyue Li,[1,2] Liangyu Che,[1] and Junhao Lin[1,2,a)]

AFFILIATIONS

[1]Department of Physics and Shenzhen Institute for Quantum Science and Engineering (SIQSE), Southern University of Science and Technology, Shenzhen 518055, China
[2]Shenzhen Key Laboratory of Advanced Quantum Functional Materials and Devices, Southern University of Science and Technology, Shenzhen 518055, China
[3]MinJiang Collaborative Center for Theoretical Physics, College of Physics and Electronic Information Engineering, Minjiang University, Fuzhou 350108, China

[a)]**Author to whom correspondence should be addressed:** linjh@sustech.edu.cn

ABSTRACT

Grain boundaries (GBs) frequently emerge in a CVD-grown large-scale transition metal dichalcogenides monolayer thin film, which affect the electronic and optical properties of the material. Photoluminescence (PL) can be easily quenched/enhanced at GBs, which are, however, merely investigated in relatively large tilt angles ($\theta > 14^\circ$) in previous research. Here, we experimentally examine the PL properties of monolayer WS_2 GBs with tilt angles as small as a few degrees. Contrary to conventional wisdom, we find that PL intensity remains intact by the GBs when their tilt angles $\theta \leq 8^\circ$. The abnormal PL behavior is elucidated by a detailed structure analysis on the dislocation cores. For a small tilt angle, the strain fields introduced by the defective cores are sparsely distributed without mutual coupling, and the chemical stoichiometry along the GBs preserves very well. These two key structural features of the small-tilt-angle GBs allow excitons to diffuse transparently across the GB, leading to a neglectable influence on the optical and electronic properties, as verified by our first-principle simulations. The PL invariant of the small-tilt-angle GBs sheds light on the future development of CVD-grown wafer-scale techniques and their optical applications.

Two-dimensional transition metal dichalcogenides (TMD) materials have great potential for optoelectronics and nanoelectronics[1–4] due to their tunable electronic structures and ambient stability. Large-scale samples are needed for commercial applications, and the fabrication methods are constantly evolving. Among them, substrate-engineering chemical vapor deposition (CVD) techniques are intriguing because of their high film quality and technical controllability.[5–10] Unfortunately, grain boundaries (GBs), which are generally believed to be a disadvantage to the optoelectronic properties, are usually unavoidable in wafer-scale crystal production if the substrate is polycrystalline.

GBs are formed from the coalescence of various oriented domains due to multiple nucleation points on the substrate.[6,8] As a result, defective structures of GBs are inevitable, which substantially affect the optoelectronic properties of the material. For example, the carrier mobility changes[11,12] and exotic magnetism emerge in non-magnetic parent materials due to GB-related alternation of the electronic structures.[13] Particularly, a notable phenomenon is the quenching or enhancement of the photoluminescence (PL) intensities at GB sties with large tilt angles.[14–17] Previous research usually correlates such changed PL intensities with the significantly defective large-angle GB motifs such as the structural distortion,[18,19] non-stoichiometry,[15] and strain field.[20,21] These structural deviations may induce a direct–indirect bandgap transition[22–26] or increased (or decreased) charge density[15] at the GB sties, which in turn influences the excitonic properties and, thereby, the PL spectra.

Therefore, a systematic understanding of the GB microscopic motifs and their correlation to the optoelectronic properties is of great importance for large-scale sample growth techniques and their potential applications. However, as explicitly stated before, previous reports usually pay much attention to the large tilt angle GBs (typically