Direct measurement of ferromagnetic hysteresis loops on $(MnTe)_x/Bi_2Te_3$ interface using spin-polarized STM

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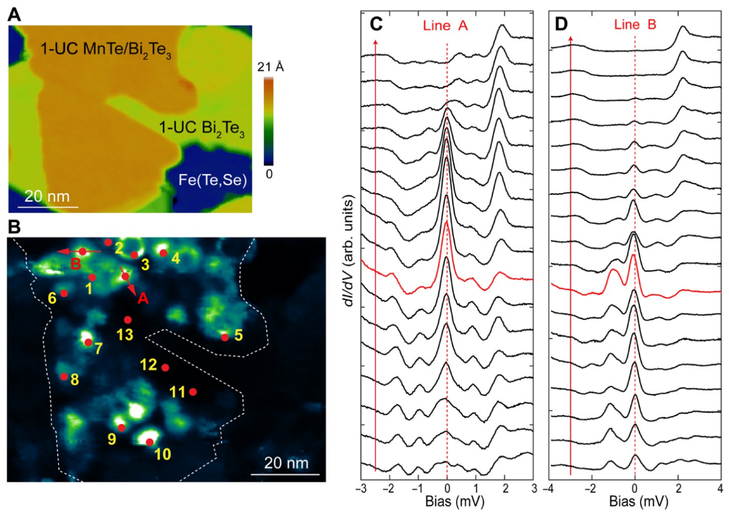
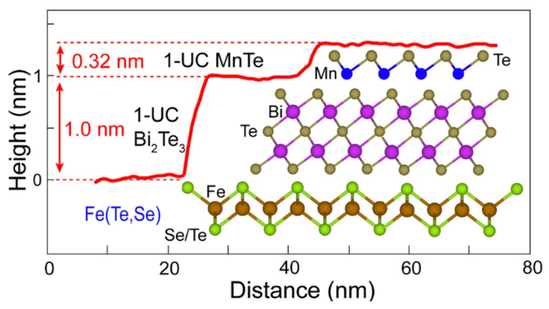
Introduction

$MnTe / Bi_2Te_3 / Fe(Te,Se)$ heterostructure

Robust zero-energy state



Lattice structure

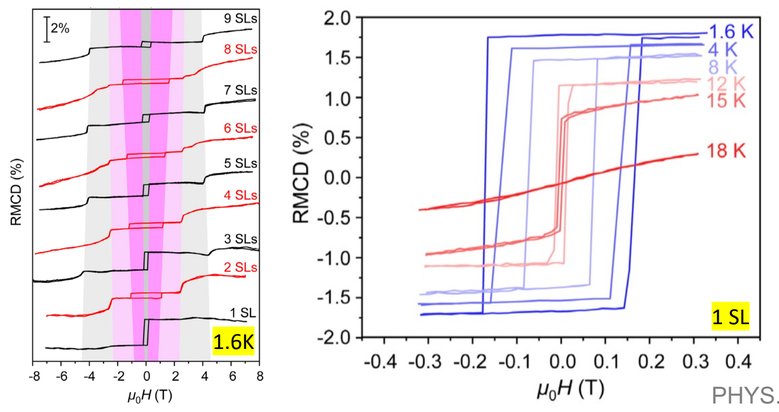


Ding et al., Sci. Adv.8, eabq4578(2022).

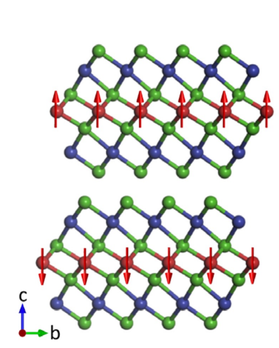
Possible Noncolinear spin texture at the interface of $MnTe/Bi_2Te_3$?

Magnetism of few-layer $MnBi_2Te_4$

RMCD under out-of-plane field



A-type AFM



PHYS. REV. X 11, 011003 (2021)

Out-of-plane coercive field for 1SL:

✦ T=4K $\mu_0 H_c \approx 0.16\mathrm{T}$ ✦ T=8K $\mu_0 H_c \approx 0.08\mathrm{T}$

Sample preparation

$(MnTe)_x / Bi_2Te_3$ interface

Graphitize 6H-SiC(0001)

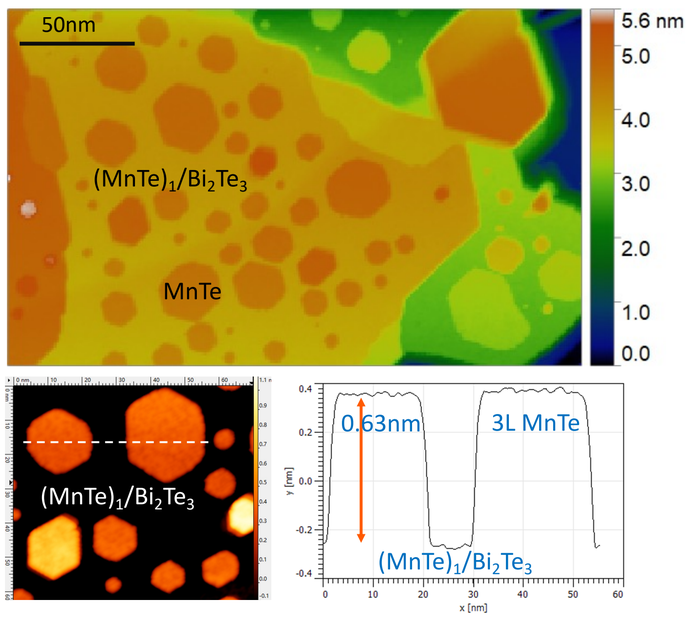
↓

MBE grow **Bi2Te3**
(180˚C, anneal at 200˚C)

↓

MBE grow **MnTe**
(180˚C, anneal at 200˚C)

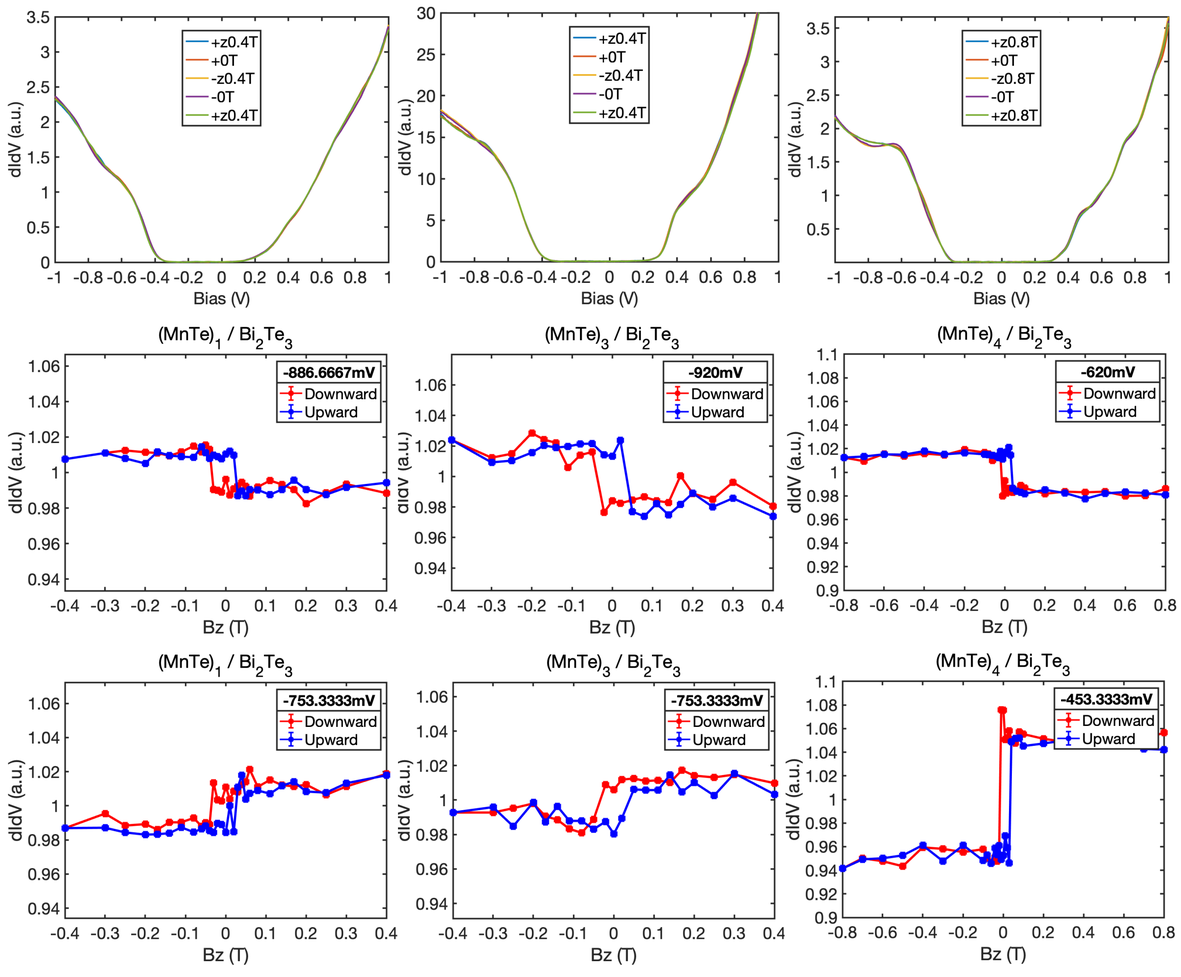
Topography



Small MnTe islands are laid above widespread $(MnTe)_1/Bi_2Te_3$/graphene

Energy-dependent FM hysteresis loops

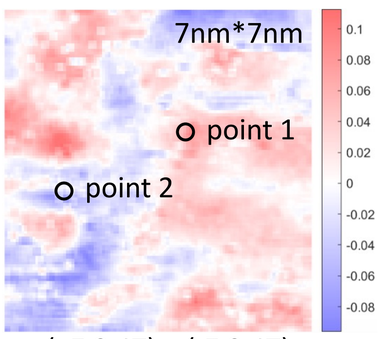
$(MnTe)_1/Bi_2Te_3$ $(MnTe)_3/Bi_2Te_3$ $(MnTe)_4/Bi_2Te_3$



(dIdV under +B) v.s. (dIdV under -B) which one is larger?
Depends on whether the energy is in spin-majority band or it's in spin-minority band

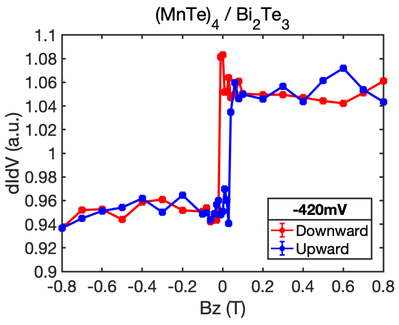
Spatial-dependent FM hysteresis loops

dI/dV relative difference

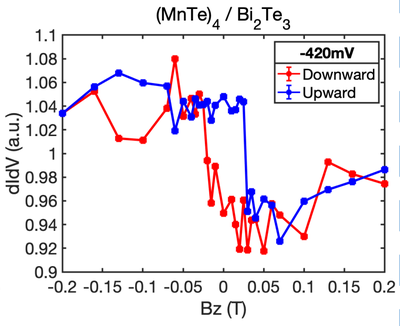


(+Z 0.4T) – (-Z 0.4T)

Point 1

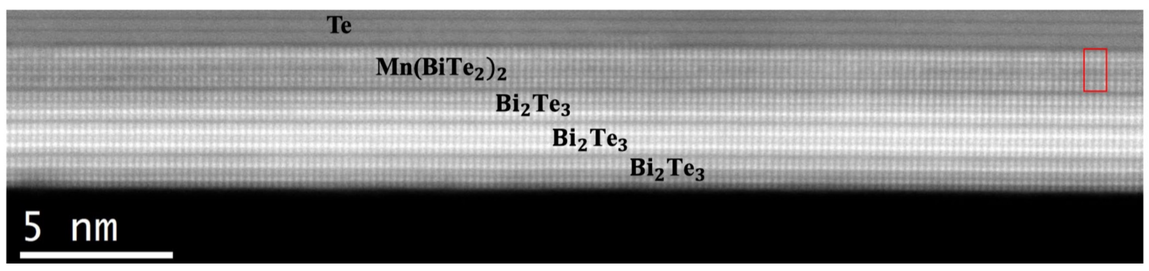


Point 2

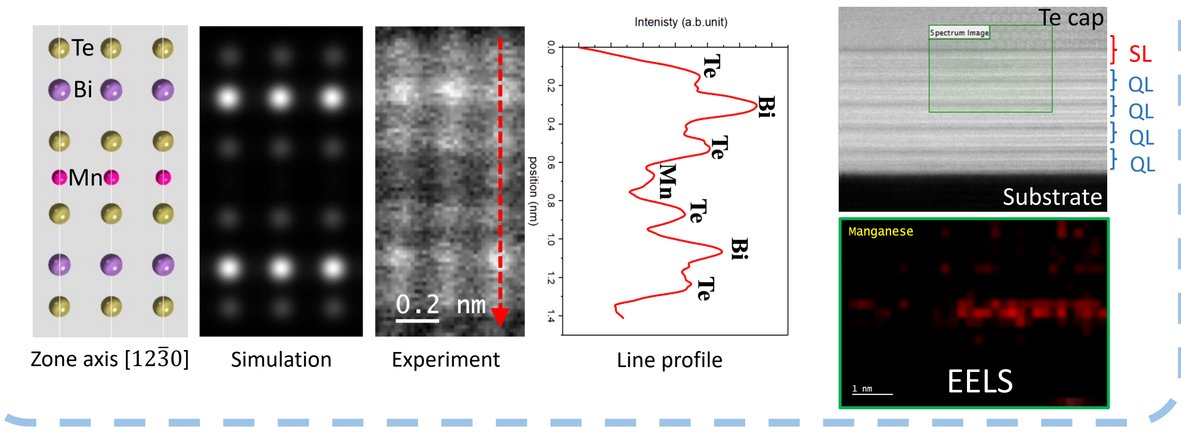


Possible spin-polarized quasiparticle interference?

STEM result (side view)



Widespread $(MnTe)_1/Bi_2Te_3$ is in septuple-layer(SL) structure indeed



Summary

1. Using spin-polarized STM, we directly measured the ferro-magnetic (FM) hysteresis loops on $(MnTe)_x$ / Bi_2Te_3 interface.

2. The spatial-dependent FM loops may be due to the spin-polarized quasi-particle interference.

We thank Ms. Guangyi Huang for helpful discussions on STEM sample preparation.