Proximity effect of Bismuth films probed by scanning tunneling microscope

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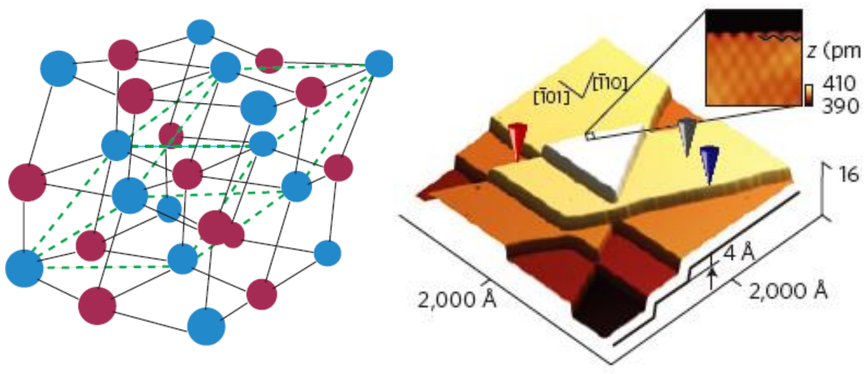
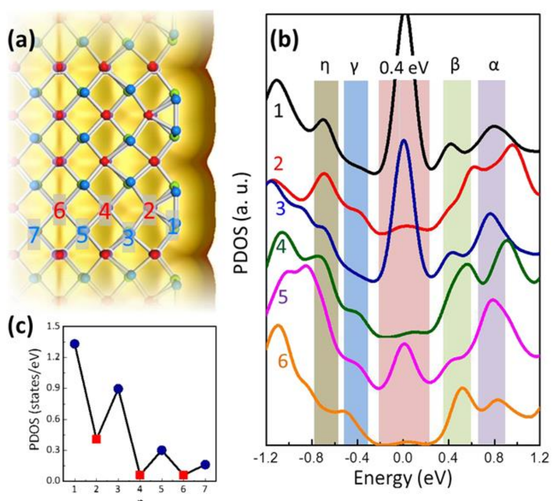
I. Introduction & Motivation

Bismuth structure



I.K. Drozdov, Nature Physics, 10 (2014).
J.T. Sun et al, Phys Rev Lett, 109 (2012).

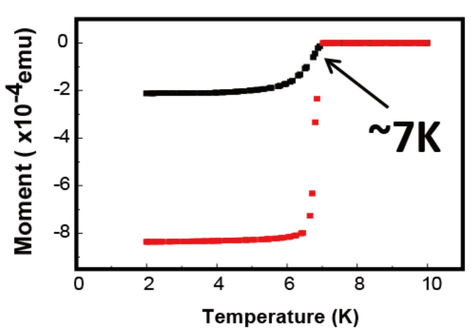


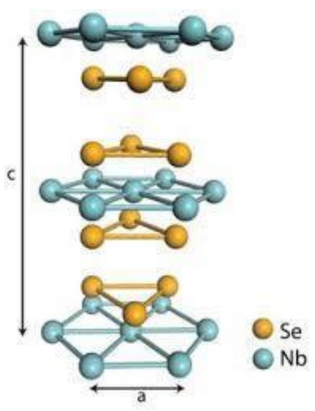
Motivation

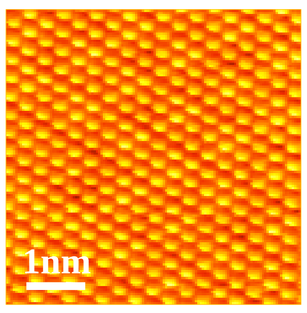
- Obtain Bismuth thin films on a superconducting substrate
- Study the proximity effect of Bismuth with superconductor
- Study the edge state
- Probe for the possible Majorana fermions

II. Experiments

$NbSe_2$ substrate



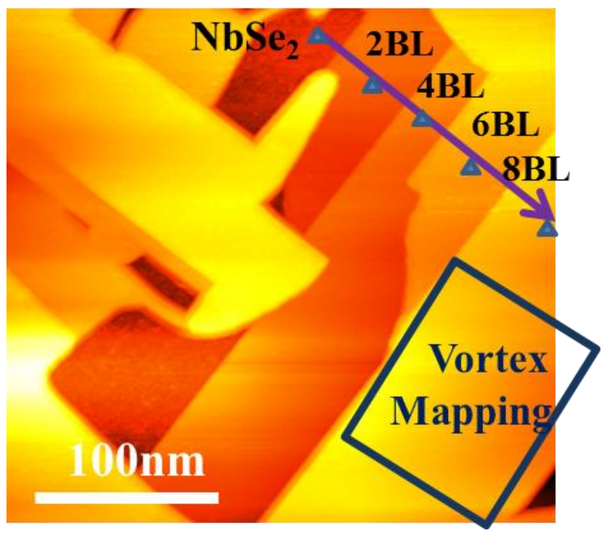




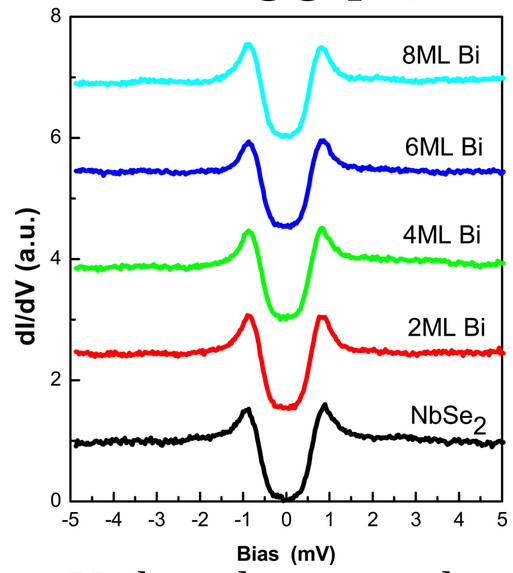
- Hexagonal lattice
- a=3.445Å c=12.55Å
- Transition Tc ~7K
- Se terminal surface

Proximity effect of superconductivity

Thickness dependence



Superconducting gap @ 0.4K

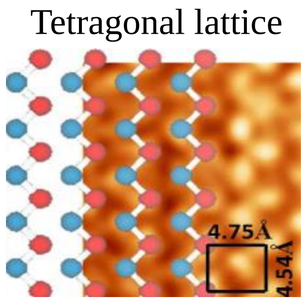


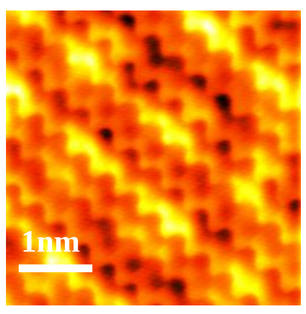
Using low temperature STM, we observe a U-shaped superconducting gap on different Bismuth layers at 400mK.

Topography of Bi surface

Bi (110) surface

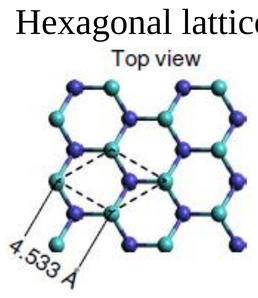
Tetragonal lattice

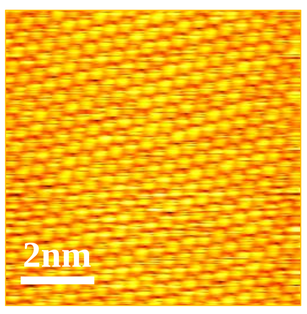




Bi (111) surface

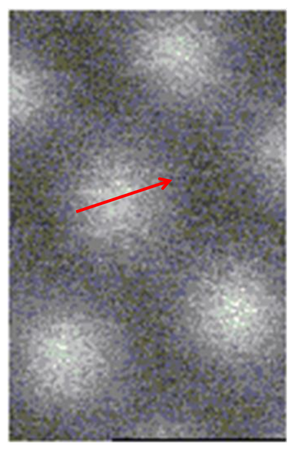
Hexagonal lattice

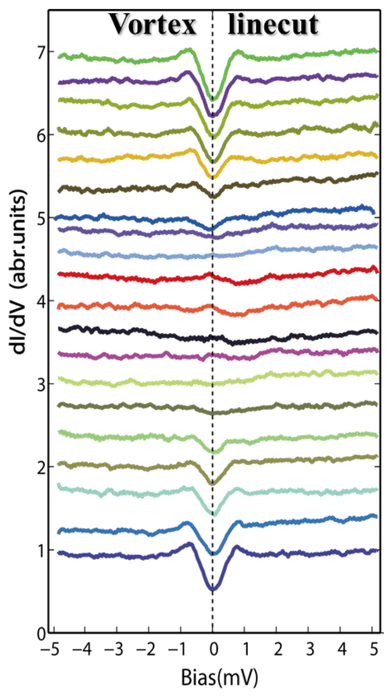


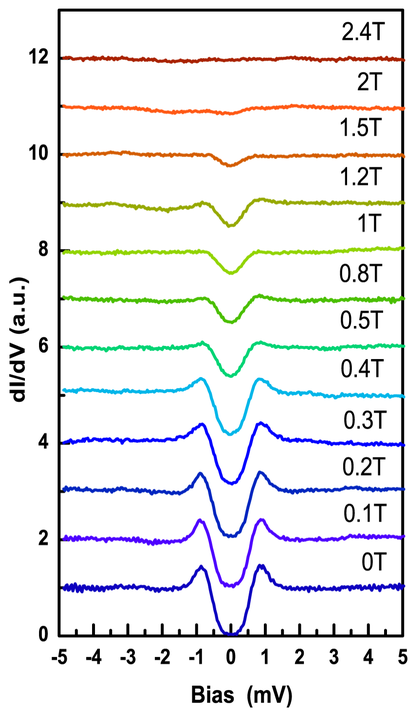


We obtain both (110)&(111) surface of Bismuth films on $NbSe_2$ substrate.

Vortex measurement on Bi surface







Vortex is detected on the surface of the Bi thin films. The U-shaped gap is gradually suppressed when applying a magnetic field up to 2 T.

III. Conclusions

- Obtain Bismuth films with different thickness on $NbSe_2$ substrate.
- U-shaped gap is observed on both (110)&(111) surface of Bismuth films.
- Vortex is measured on Bismuth thin films.

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