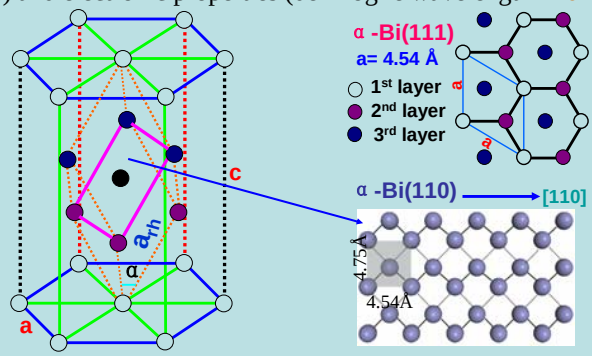
Self-assembly of Bi nanostructure on HOPG, MoS_2 and silicon nitride

Chu, X.J.; Zhang, H.L.; Kushvaha, S.S.; Tang, Z.; Tang P. and Wang, X.S.

Department of Physics, Faculty of Science, National University of Singapore, Singapore 117542
(g0600514@nus.edu.sg)

INTRODUCTION

◆ Bismuth, a group-V semimetal, has unique atomic (***Rhombohedral*** lattice) and electronic properties (de Broglie wavelength ***~40 nm***).

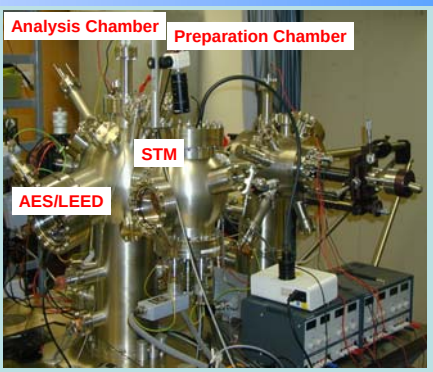


◆ HOPG (Highly Oriented Pyrolytic Graphite) and MoS_2 are easy-to-prepare inert conductive substrate for growing nearly ***free-standing*** nanostructures, sometimes ***1D or quasi 1D*** nanostructures.

◆ Si-based inert surfaces: dielectric layers (SiO_2, ***Si_3N_4***, $SrTiO_3$) on Si, close to real applications.

◆ In this work, Bismuth was deposited on HOPG, MoS_2 and Si_3N_4. ***Nanorods, nanoribbons and nanoclusters*** were formed.

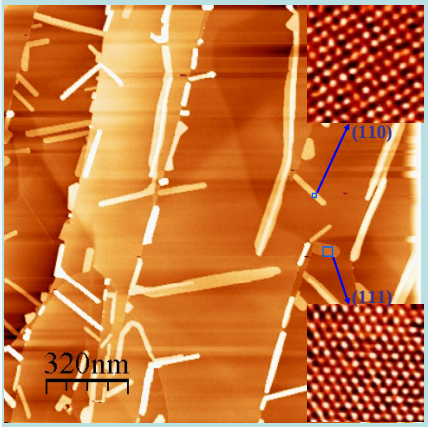
EXPERIMENTAL DETAILS



◆Base Pressure:1×10^{-10} mbar
◆Bi **evaporator boat**
◆Flux calibrated with **STM & AES**
◆HOPG and MoS_2 sample **cleaved in air** and degassed in vacuum at 700~800K
◆Si_3N_4 prepared by **thermal nitridation** of Si(111)-7x7
◆STM images at ***RT***

RESULTS AND DISCUSSIONS

I. Bi nanorods on HOPG



➢ Low surface coverage

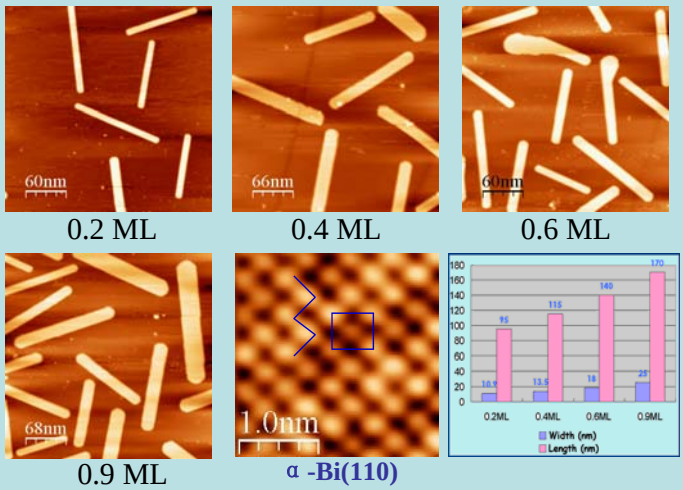
➢Edge-decoration with Bi nanorods

➢ Heights range from 6.6Å to 33Å

➢ Nanorods with height of 8Å: **α-Bi(111) surface**

➢ Nanorods with height of even number of 3.3Å (one atomic layer spacing): **α-Bi(110) surface**

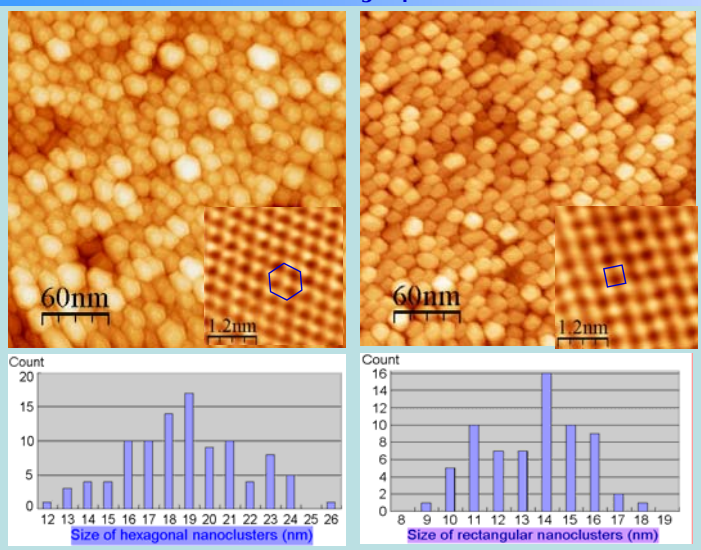
II. Bi nanoribbons on MoS_2



➢ ***Uniform*** height of 6.6 Å

➢ Angles between the nanoribbons are 0º, 60º or 120º, corresponding to the ***three-fold symmetry*** of the substrate.

III. Bi nanoclusters on Si_3N_4



➢ Silicon nitride surface was ***passivated with Bi***

➢ Bi forms single crystal faceted clusters at ***room temperature***

➢ Coexistence of ***hexagonal*** and ***rectangular*** facet clusters

CONCLUSION

◆ The Bi(110) islands with even-number layers is stabilized by forming a puckered-layer structure

◆ There is a natural tendency for faster diffusion along <110> directions in a low flux environment

◆ The direction <110> corresponding to the direction of the long zigzag chains of covalently bonded atoms, likely produces very elongated structures.

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