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High Crystalline Epitaxial Bi2Se3 Film on Metal and Semiconductor Substrates

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The binary chalcogenide semiconductor Bi2Se3 is at the center of intensive research on a new state of matter known as topological insulators. It has Dirac point in their band structures with robust surface states that are protected against external perturbations by strong spin-orbit coupling with broken inversion symmetry. Such unique band configurations were confirmed by recent angle-resolved photoelectron emission spectroscopy experiments with an unwanted n-type doping effect, showing a Fermi level shift of about 0.3 eV caused by atomic defects such as Se vacancies. Since the number of defects can be reduced using the molecular beam epitaxy (MBE) method.

We have prepared the Bi2Se3 film on noble metal Au(111) and semiconductor Si(111) substrates by MBE method. To characterize the film, we have introduced several surface sensitive techniques including x-ray photoemission electron spectroscopy (XPS) and micro Raman spectroscopy. Also, crystallinity of the film has been confirmed by x-ray diffraction (XRD). Using home-built scanning tunneling microscope, we observed the atomic structure of quintuple layered Bi2Se3 film on Au(111).

Keywords: topological insulator, bismuth selenide, scanning tunneling microscopy