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Stability of near surface crystallographic structure of Bi_2Te_3 upon Au deposition

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Bismuth chalcogenides belong to the group of layered materials that exhibit excellent thermoelectric properties associated with good electronic and low thermal conductivity. Single crystals of selected bismuth chalcogenides reveal also the unique characteristics of Topological Insulators (TI). The best recognized feature of TI is the existence of metallic states whenever the TI material breaks its continuity, e.g. on the surface.[1] These are formed by helical spin-momentum states, which forbid back-scattering of surface electrons without changing their spin, i.e. they are robust against non-magnetic perturbations. This fact can be utilized in spintronic applications and in devices carrying quantum information where avoiding decoherence is of prime importance. As evidenced by high throughput calculations, roughly 27% of all known crystal structure materials are topological, while nearly half of them are TI.[2] Topological character of materials is protected by symmetries that are locally preserved by specific surfaces. This is why it is crucial to probe both surface states and crystal structure (symmetries) in the near surface region, in order to determine stability limits of TI surface.

To determine the possible influence of metallic contacts on electronic structure of future TI devices we have recently performed STM/STS observations of the influence of Au deposition on Bi_2Te_3 surface. We observed that the position of Dirac cone with respect to Fermi level is intact near small Au islands at cryogenic temperature, while it is weakly affected in vicinity of large Au clusters formed at room temperature. The effect seems to correlate with the morphology of Au deposit, which exhibits Volmer-Weber growth mode. A typical island's height of 0.4 nm for 0.2 monolayer (ML) of Au adsorbate is observed at cryogenic temperature, while a strong tendency to formation of significantly larger clusters upon room temperature deposition is seen. To shed more light on the origin of the DC shift effect (electronic or/and structural) we have employed polarized beam of monochromatic X-rays delivered by Solaris synchrotron to probe local crystal structure of Bi_2Te_3. The technique of choice was X-ray Linear Dichroism (XLD) at Te M-edge. When probed with total electron yield detection it is sensitive to structural anisotropy of Te sites within few nanometer thick surface volume. Measurements performed *in-situ* reveal robust structural stability upon deposition of Au amounts ranging from 0.5 to several ML. However, at higher coverage the relative XLD amplitude diminishes, which is discussed in relation to possible Au alloying with Bi_2Te_3.[3]

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