Influence of au nanoparticles on the topological surface states of Bismuth chalcogenideS

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In this work we investigate the influence of nano-size Au particles on the topological surface states (TSS) of bismuth chalcogenide (Bi2Se3 and Bi2Te3) topological insulators (TI). The research aims to clarify how the Au affects the TSS: whether it leads to a shift of the electronic structure of TSS (e.g. Dirac point) with respect to the bulk band gap or it leads to the destruction of TSS by opening the energy gap. Both contradicting scenarios were reported in literature in the case of Bi2Se3.

The single crystals of TI were synthesized by the Bridgman method. The Au of sub-monolayer thickness (0.02 ÷ 0.2 ML) was deposited on the *in situ* cleaved surface of TI using molecular beam epitaxy under ultra-high vacuum. Deposition and measurements have been done at room and liquid nitrogen temperatures. The topography of the modified surface was investigated by scanning tunneling microscopy. We observed Volmer-Weber growth mode of Au with typical island’s height of 1-1.5 nm for the Au adsorbate amount of 0.2 ML.

The electronic surface states of TI were probed locally by scanning tunneling spectroscopy (STS) [1, 2]. The STS measurements revealed an energy shift in the electronic surface states for Au-covered samples (on the order of ~ 20 and ~ 50 meV, for Bi2Te3 and Bi2Se3, respectively). Furthermore, we checked how the distance from Au nanoparticle influences the STS characteristics. We found a gradual changes in the electronic surface states while approaching the Au nanoparticle, starting from ~10 nm from the particle border.

[1] K. Nowak et al., Materials 15, 2083 (2022)

[2] M. Jurczyszyn et al., Applied Surface Science 528, 146978 (2020)