Bulk and surface – related nature of Ge(111) spin-orbit split bands

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Abstract

The emergence of the spin-orbit interaction (SOI) manifests in condensed matter in either momentum-splitting of the bands when the SOI is Rashba-like or energy-splitting when the SOI is of atomic origin. In Ge(111) both mechanism are active. Our density functional theory (DFT) and photoemssion results discuss the nature of both type of interactions and their signature in the experimental band structure.
By using soft X-ray ARPES, with its intrinisic 3D resolution we probe the bulk band structure of epitaxial Ge(111) grown on either Ge(111) substrate or on Si (111).
The epitaxial-induced strain lifts the degeneracy of the light and heavy hole bands, while compared to Si case, the larger Z of Ge promotes also stronger atomic SOI.
The signatures of these effects are distinguished and separated while applications of these findings are discussed.