ARPES study: metal-Weyl (Pb-NbP) semimetal interface

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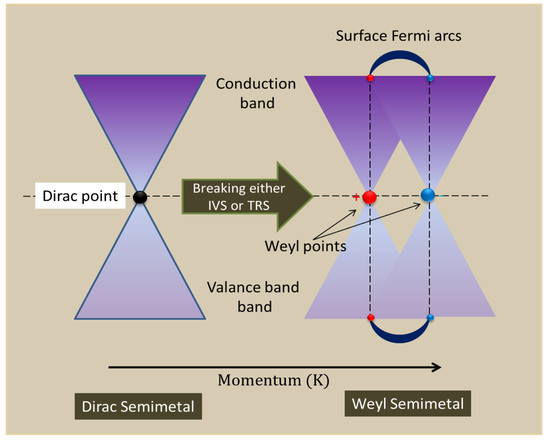
Abstract

From the point of view of the electronic structure of topological Weyl semimetals (WSM), the most relevant feature is the existence of open Fermi surfaces, surface Fermi arcs, emerging at the surface and their interplay with bulk Weyl fermions[1,2]. Both from the point of view of basic research and applications it is very relevant to find an effective way of controlling and modification of Fermi arcs e.g. of switching them between pairs of Weyl-points[3,4].
We used ARPES to study early stages of Pb/NbP interface formation and the corresponding modifications of surface states on both P- and Nb-terminated NbP (001) faces. We got experimental evidence that Pb deposition quantitatively changed surface band structure on both faces. The Fermi surface pockets marked out by Fermi arcs on P-terminated face, the fingerprints of WSM character of investigated system, were changed . Non-trivial surface states changes the connection and connects two adjacent Brillouin zones due to topological quantum Lifshitz transition (TQLT).



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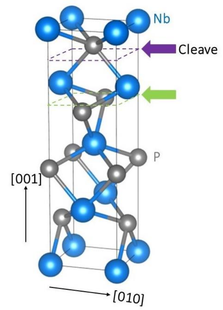
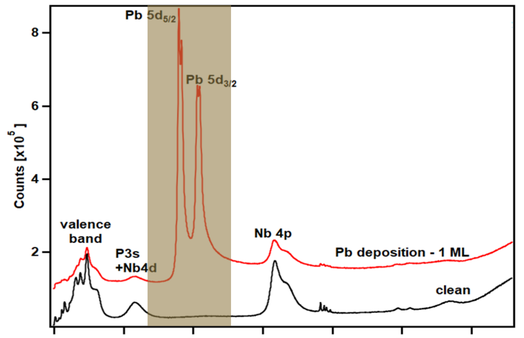
Pb deposition on NbP

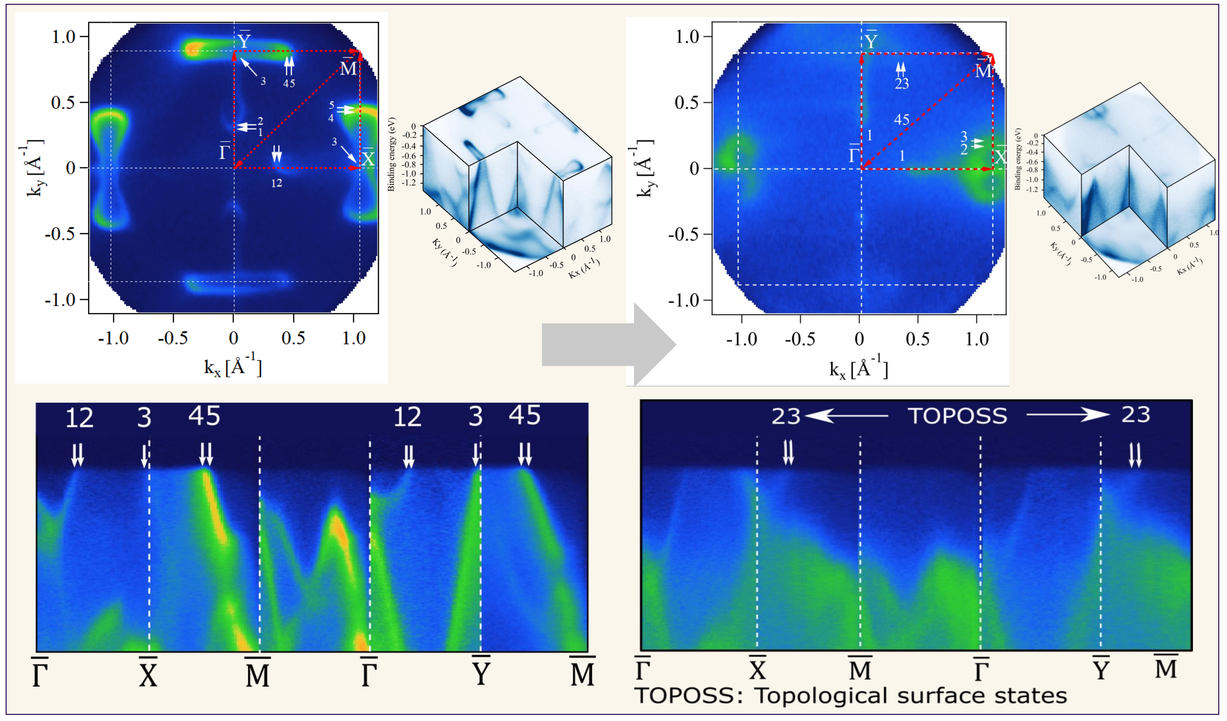


Crystal structure of NbP

Joule heat evaporator

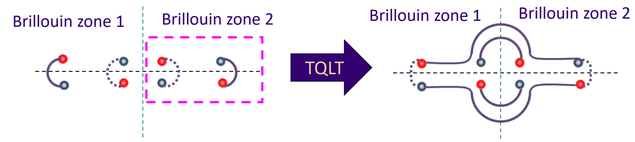


Core level spectra before and after Pb deposition



Comparison between pristine NbP and Pb deposited NbP with surface modifications shown at const. E contour and experimental bandstruture

Topological Quantum Lifshitz Transition



Summary

- High quality single crystal are prepared by Chemical Vapor transport route
- Single crystals are cleaved in Ultra high vacuum (in-situ)
- P terminated NbP shows Bow-tie (trivial) and spoon (non-trivial) surface states in the ARPES spectra
- 1 ML of Heavy metal (Pb) deposition on (0 01) surface of NbP manipulates the Fermi arcs and changes the bandstruture
- Topological quantum Lifshitz transition is responsible for manipulation of Fermi arcs

References

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