One-Dimensional Spin-Polarized Surface States on Bi(112) Compared to States on Other Vicinal Surfaces of Bi

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Vicinal surfaces of bismuth have been found to be great test-beds for investigating one-dimensional (1D) spin-polarized surface states that can be used in spintronic devices [1,2]. We used angle-resolved photoemission spectroscopy (ARPES) and spin-resolved ARPES together with tight-binding (TB) and density functional theory (DFT) calculations to investigate two such surface states on Bi(112). The surface states resemble elongated Dirac cones: 1D and close to dispersionless in the k_y direction, but dispersing in energy along the k_x-direction, forming elongated, X-like features (see Figure). The spin-polarization is pointing mainly in-plane and along the 1D lines, but there are signs of an out-of-plane component for one of the two states. In this talk, we will compare the energy vs. momentum (E vs. k) dispersion and spin-polarization of the measured surface states of Bi(112) to those calculated from the tight-binding model, and the surface states on two other vicinal surfaces of bismuth [1,2]. Similar surface states were found on all three surfaces, suggesting that their existence and general properties are robust properties of bismuth vicinal surfaces. In addition, differences in the details of the states, especially regarding spin-polarization, indicate that their properties may be tuned simply by cutting and polishing the crystal precisely along different high-symmetry directions.

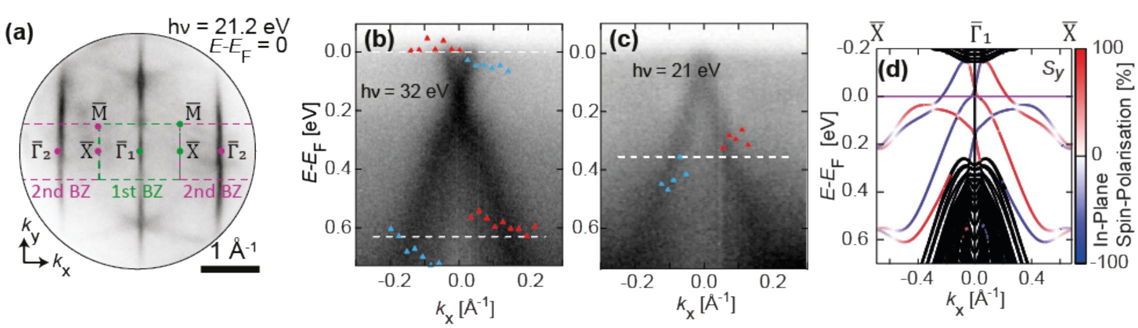

Figure 1: (a) The Fermi-surface of Bi(112). Dashed rectangles are the 1st and 2nd surface Brillouin zone (BZ). (b), (c) Energy vs. momentum images measured at $h\nu$=32 eV (b) and $h\nu$=21 eV (c). The measured in-plane spin-polarization is overlaid. (d) In-plane spin-polarization as calculated from a tight-binding model.

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[2] J. W. Wells, Phys. Rev. Lett. **102**, 9(2009)

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