Supplemental Material for 'Kinetic stabilization of 1D surface states near twin boundaries in non-centrosymmetric BiPd'

Chi Ming Yim,[1] Christopher Trainer,[1] Ana Maldonado,[1,2] Bernd Braunecker,[1] Alexander Yaresko,[2] Darren C. Peets,[2,3] and Peter Wahl[1]

[1] *SUPA and School of Physics and Astronomy, University of St Andrews, North Haugh, St Andrews, Fife, KY16 9SS, UK*

[2] *Max-Planck-Institut für Festkörperforschung, Heisenbergstr. 1, 70569 Stuttgart, Germany*

[3] *Advanced Materials Laboratory, Fudan University, Shanghai 200438, China*

(Dated: October 19, 2018)

SUPPLEMENTAL NOTES

Further characterization of twin boundaries

Fig. S2 shows a topographic image and spectroscopic data of the superconducting gap near a twin boundary. The measurements were performed at a temperature of 30 mK. In the field-of-view in Fig. S2(a), we recorded $\mathrm{d}I/\mathrm{d}V$ spectra at the twin boundary, as well as at the terraces as marked by different color boxes in Fig. S2(a). Our spectroscopic data [Fig. S2(b)] show that the superconducting gap persists at the twin boundary with only minor changes. The data have been obtained with a superconducting tip.

Fig. S3 shows further spectroscopic data of the twin boundary bound state, and how it is affected by defects. These data were taken using a different tip. We find that the twin boundary bound state is completely suppressed in the vicinity of defects as well as once the defect concentration becomes too high.

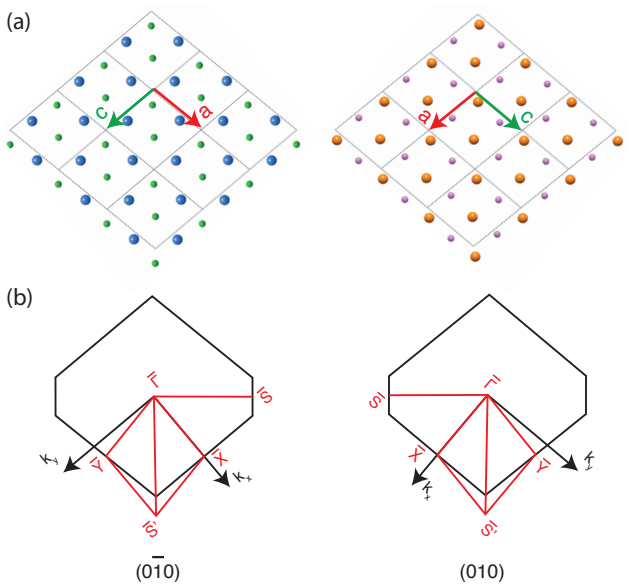

FIG. S1. (a) Schematic models of the (left) (0$\bar{1}$0) and (right) (010) terminations of the non-centrosymmetric BiPd. Large blue and orange spheres are Bi atoms, small green and pink spheres are Pd atoms. The models are aligned with their [101] directions running parallel to each other, like the (0$\bar{1}$0) and (010) domains which are separated by a twin boundary as shown in Fig. 1 in the main text. (b) Surface Brillouin Zones of the two terminations.

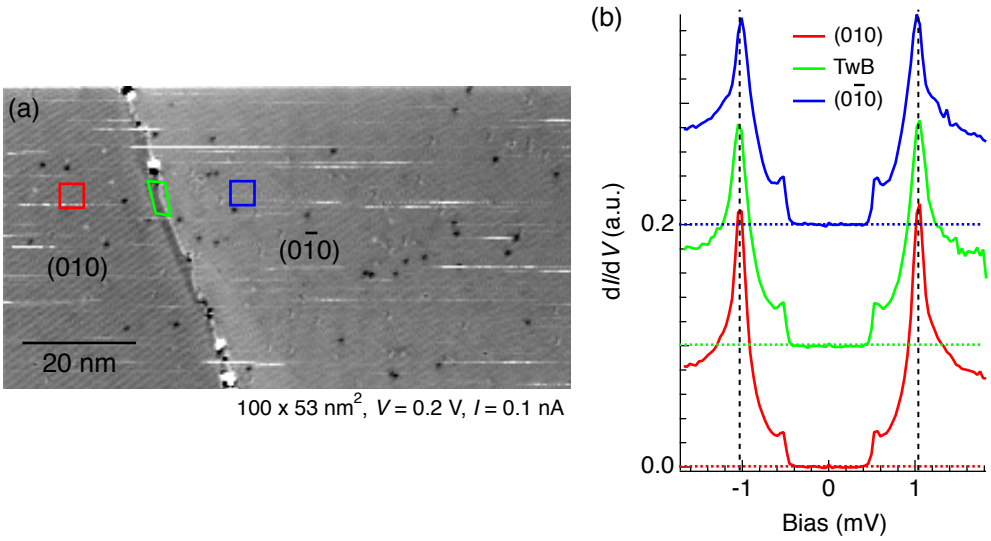

FIG. S2. (a) STM topographic image of a twin boundary separating two atomically flat domains of (010) and (0$\bar{1}$0) terminations of the crystal lattice. (b) Averaged dI/dV spectra recorded from different positions in the field-of-view in (a), which include the (010) (red) and (0$\bar{1}$0) (blue) terraces, and the twin boundary (green). The spectra were taken at temperature of 30 mK using a superconducting tip, prepared by picking up a BiPd chunk from the surface, leading to two pairs of superconducting coherence peaks showing up in the spectra. The spectra taken from different positions do not show any appreciable difference in the superconducting gap size.

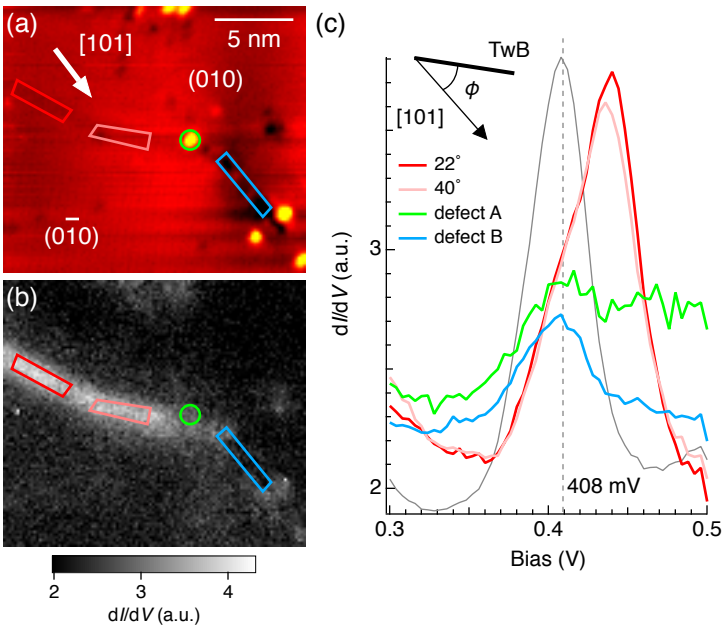

FIG. S3. (a) STM image taken at the lower part of the twin boundary shown in Fig. 3 in the main text (19.4×15.4 nm^2). A different tip was used. (b) dI/dV map slice taken simultaneously with the STM image in (a), at a bias voltage of 0.44 V. (c) Averaged dI/dV spectra taken from the two different sections along the twin boundary as marked with red and pink rectangles in (a-b), respectively. Each section is characterized by ϕ, the angular separation between the section and the [101] direction of the BiPd surface (see inset). Spectra obtained from two different types of defects residing on the twin boundary [marked by green circles and blue rectangles in (a-b), respectively], as well as that from the (0$\bar{1}$0) terrace, are also included.