

# Point-contact exploration of the superconducting state in Te-doped $\text{PtBi}_2$

O. E. Kvitnitskaya<sup>1,2</sup>, S. Ash<sup>2</sup>, Yu. G. Naidyuk<sup>1</sup>, B. Büchner<sup>2,3</sup>

<sup>1</sup>B. Verkin Institute for Low Temperature Physics and Engineering, NASU, Kharkiv, Ukraine

<sup>2</sup>Leibniz Institute for Solid State and Materials Research, IFW Dresden, Dresden, Germany,

<sup>3</sup>Institut für Festkörper- und Materialphysik and Würzburg-Dresden Cluster of Excellence ct.qmat, TU Dresden, Dresden, Germany

## Abstract

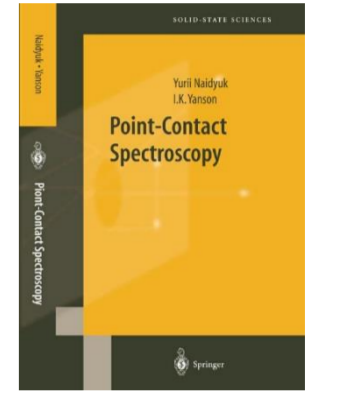
$\gamma\text{-PtBi}_2$  is a Weyl semimetal, exhibiting superconductivity with critical temperature  $T_c \approx 0.6\text{--}1.1$  K. Notably, surface-sensitive spectroscopic measurements reveal an enhanced  $T_c$ , suggesting the realization of unconventional surface superconductivity. Bulk superconductivity with a much higher  $T_c \approx 2.4$  K was discovered in the partially tellurium-substituted compound  $\text{PtBi}_{2-x}\text{Te}_x$ . We measured two types of Te-substituted  $\text{PtBi}_2$  compounds with 2 and 10% of Te applying point-contact (PC) technique. For all PCs, differential resistance  $dV/dI$  showed typical zero-bias minimum due to the superconducting transition. The average  $T_c$  for the all measured  $\text{PtBi}_{1.96}\text{Te}_{0.04}$  PCs amounted to 3.1K, which exceeds the  $T_c$  value in the bulk. The reason for the increase in  $T_c$  may be the influence of pressure during the creation of PCs. PC studies of the doped compound  $\text{PtBi}_{1.8}\text{Te}_{0.2}$  with a higher Te content showed almost no increase of  $T_c$  compared to the bulk. Another reason for the enhanced  $T_c$  could be compositional variations in  $\text{PtBi}_{1.96}\text{Te}_{0.04}$  system and the presence in the PC of some areas with stoichiometry close to pure  $\text{PtBi}_2$ , which, as measured, possesses surface superconductivity with increased  $T_c$ .

## Methods

Classical PCs were established at  $T^{\text{He}}$  by touching of thin Cu/Ag/Co wire to a cleaved surface of  $\text{PtBiTe}$  crystals (heterocontacts).

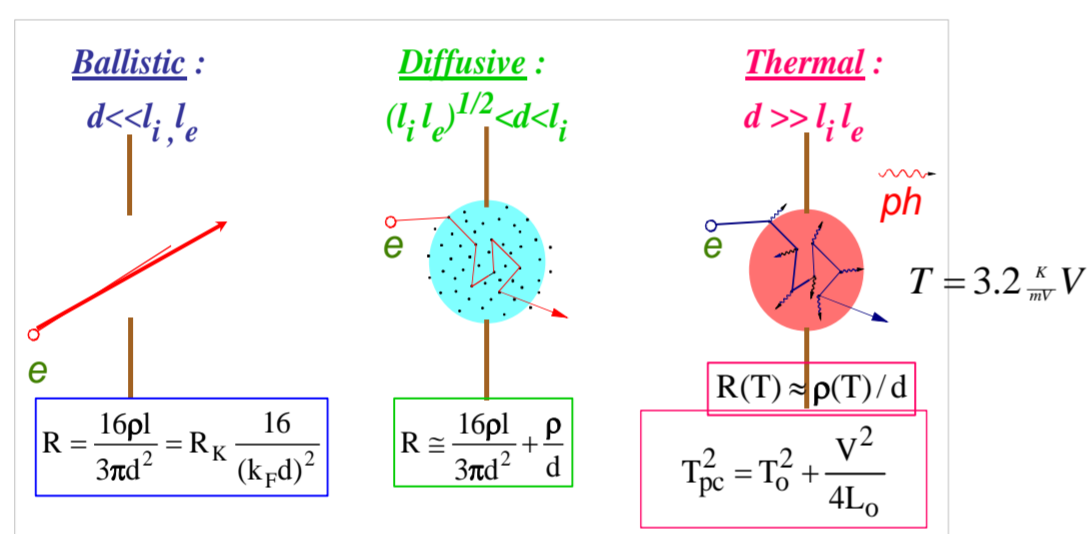
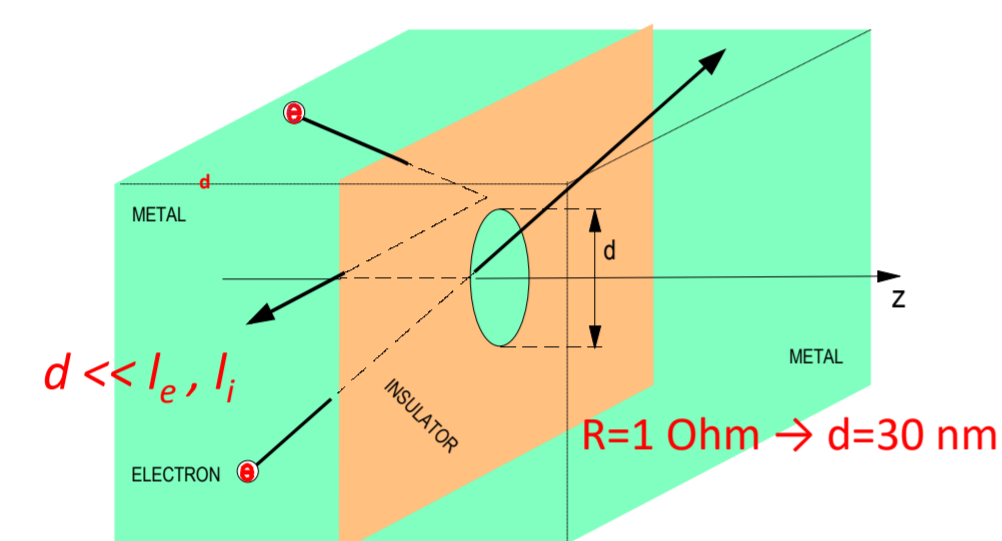
The IVC and their derivatives of PCs were measured at 1.5-10K and in magnetic field up to 4 T using point-contact spectroscopy method.

[Yu.G.Naidyuk, I.K.Yanson, Springer, 2005]



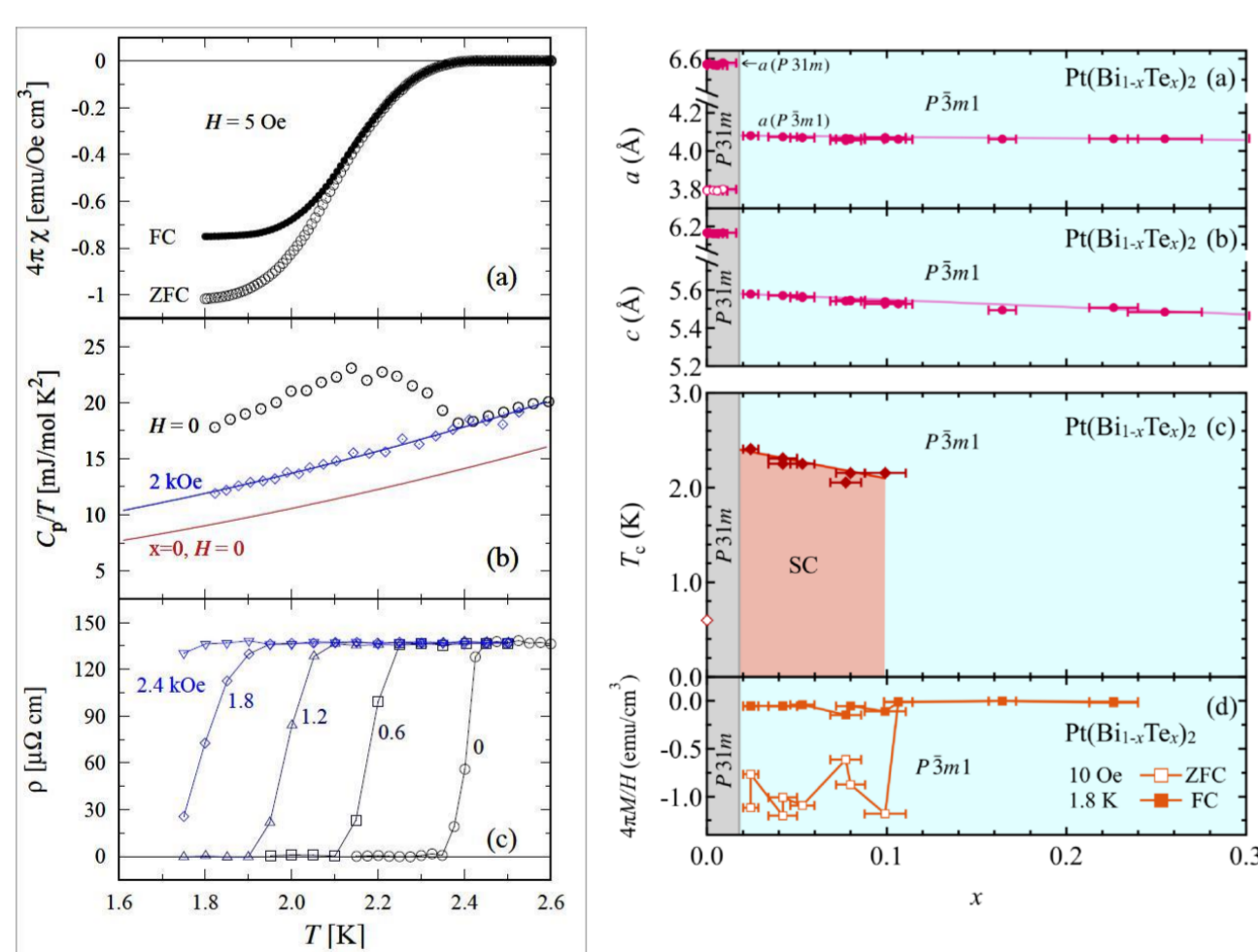
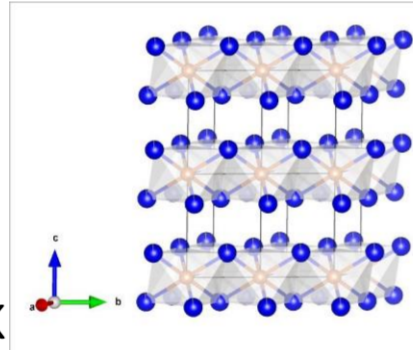
## Introduction

### Point-contact spectroscopy



### Properties of $\text{PtBiTe}$

- $\gamma\text{-PtBi}_2$  is a type I Weyl semimetal.
- superconductivity with  $T_c \sim 1$  K reported from electrical resistivity measurements
- doping with Te (2%) or Se (3%) -  $T_c \sim 2.4$  K



Bulk SC transition in  $\text{PtBi}_{1.96}\text{Te}_{0.04}$  at  $T_c \approx 2.4$  K from (a) magnetization, (b) heat capacity and (c) electrical resistivity measurements. K. Srowik *et al.*, *subm. to PRB* (2026)

The x dependence of  $T_c$  and  $4\pi M/H$  at 1.8 K measured under ZFC and FC in  $\text{Pt}(\text{Bi}_{1-x}\text{Te}_x)_2$ . Superconductivity is at  $0.024 \leq x \leq 0.099$ . K. Takaki *et al.*, *J. Phys. Soc. Jpn.* 91, 034703 (2022)

## Experimental

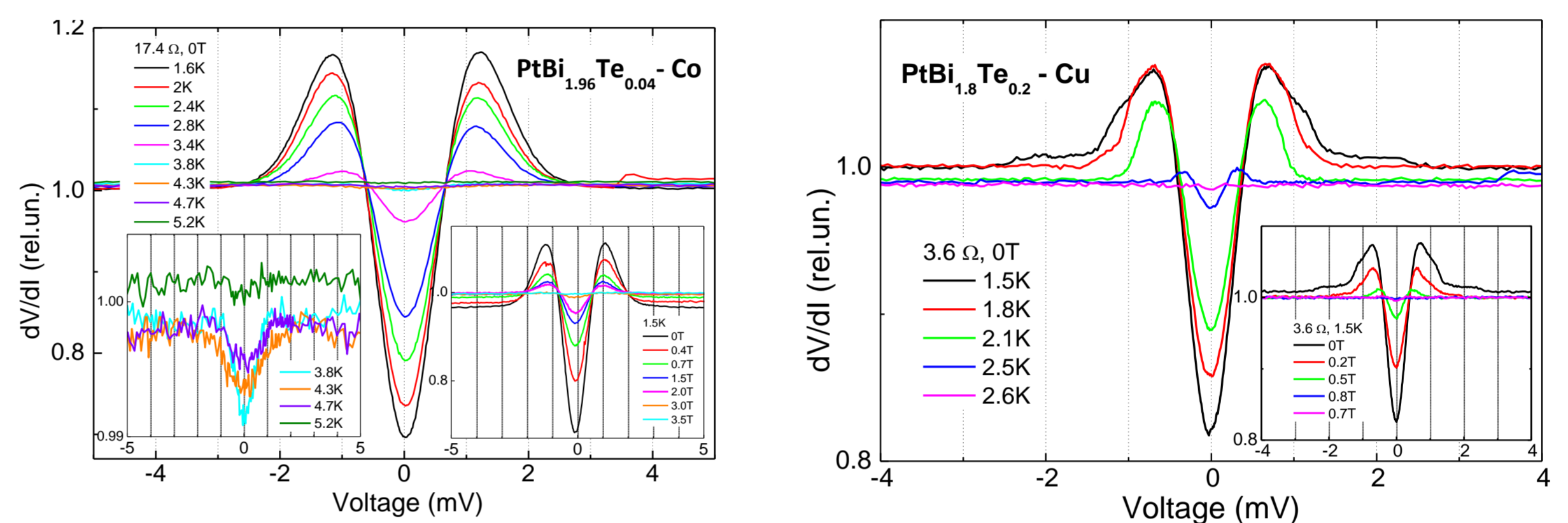


Fig. 1. Temperature variation of  $dV/dI$  of  $\text{PtBi}_{1.96}\text{Te}_{0.04}\text{-Co}$  (left) and  $\text{PtBi}_{1.8}\text{Te}_{0.2}\text{-Cu}$  (right) PCs. Right insets show  $dV/dI(V)$  in magnetic field at  $T=1.5$  K

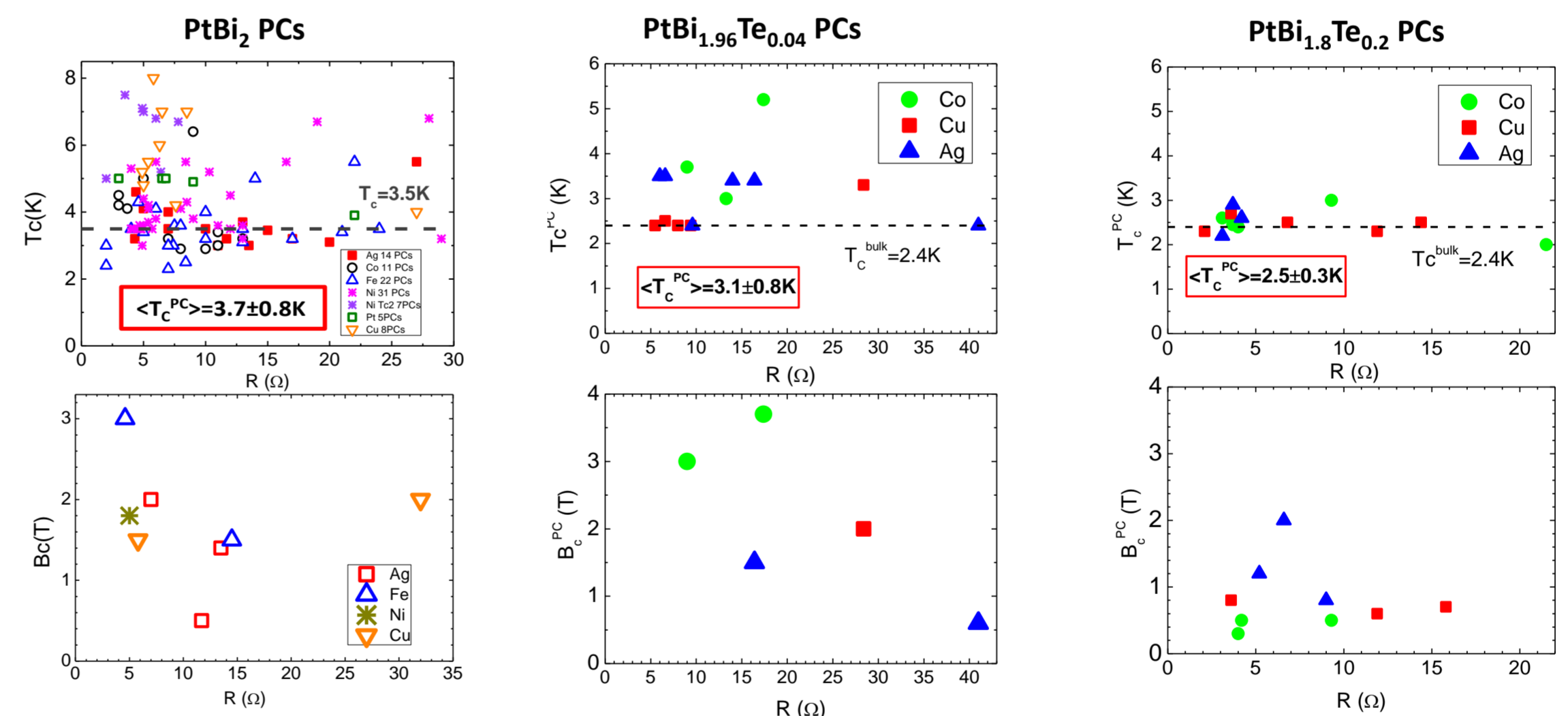


Fig. 2.  $T_c$  and  $B_c$  distribution for all measured heterocontacts on  $\text{PtBi}_2$  (a),  $\text{PtBi}_{1.96}\text{Te}_{0.04}$  (b) and  $\text{PtBi}_{1.8}\text{Te}_{0.2}$  PCs with normal (Ag, Pt, Cu) and ferromagnetic (Fe, Co, Ni) tips. The x-axis shows PC resistance in the normal state.

## Summary

- PC studies of the doped compound  $\text{PtBi}_{1.8}\text{Te}_{0.2}$  with higher Te content shows no increase of  $T_c$  ( $\approx 2.5$  K) compared to the bulk ( $\approx 2.4$  K)
- The average TC for all measured  $\text{PtBi}_{1.96}\text{Te}_{0.04}$  PCs amounted to 3.1K, which exceeds the  $T_c$  value of the bulk. An origin for the enhanced  $T_c$  could be a marginal intergrowth phase in the  $\text{PtBi}_{1.96}\text{Te}_{0.04}$  crystals due to their vicinity to the phase transition to the non-centrosymmetric, trigonal structure of pure  $\text{PtBi}_2$

kvitnitskaya@yahoo.com