Topological superconductor beta-PdBi2

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In topological superconductors, it has been predicted that special particles, so-called Majorana fermions, will appear on the surface of the material. Recently, spin- and angle-resolved photoemission spectroscopy measurements revealed that Palladium-Bismuth Superconductor, β-PdBi2 (tetragonal structure, space group I4/mmm, Tc = 5.4 K[1]), has topologically protected surface state[2] and it attracts much attention.

In order to study bulk properties of PdBi2, we performed a small-angle neutron scattering (SANS) experiment and measured diffractions from vortex lattice. For the measurements, we grew single crystals of PdBi2 by a melt growth method and Tc of the crystals was evaluated to be Tc = 5.2 K by magnetization measurements. The previous neutron diffraction measurements at SANS-1 instrument in FRM-II (from 17th to 22th August, 2017) showed us clear spots. Q-dependence of the intensity indicates the system has hexagonal vortex lattice. Then, in the present study, to confirm the anisotropy and superconducting paring symmetry, we performed experiments at same instrument.

Four single crystals of PdBi2 (0.972 g, 0.856 g, 0.746 g and 0.506 g) were set with [010] axis vertical in a 3He insert, and it was installed into a magnet with horizontal fields. First, we checked positions of the crystals by neutron camera and set masks with Cd. After confirmation of a direction of field by using Nb single crystal, we measured vortex lattice created in field cooled process. A magnetic field was rotated from parallel to [001] towards [100] of the sample, in steps of α = 0, 15, 30, 45, 60, 67.5, 75, 82.5, 90 degree. Incident neutron beam was almost parallel to the magnetic field. We used neutrons with λ = 8 . Figures 1(a)˜(c) show diffraction patterns from vortex lattice at α = 0, 45 and 67.5 degree, respectively. Clear spots were observed. We determined a, b and anisotropy factor γ (= a / b) which were illustrated in Fig.1(a). We found that γ is highly dependent on α.
Next we measured temperature dependence of integrated intensity at H = 0.1 and 0.3 T by rotating the sample with the magnetic field around omega angle (around a vertical axis) at α = 0 degree. We will determine gap structure of this material.

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References

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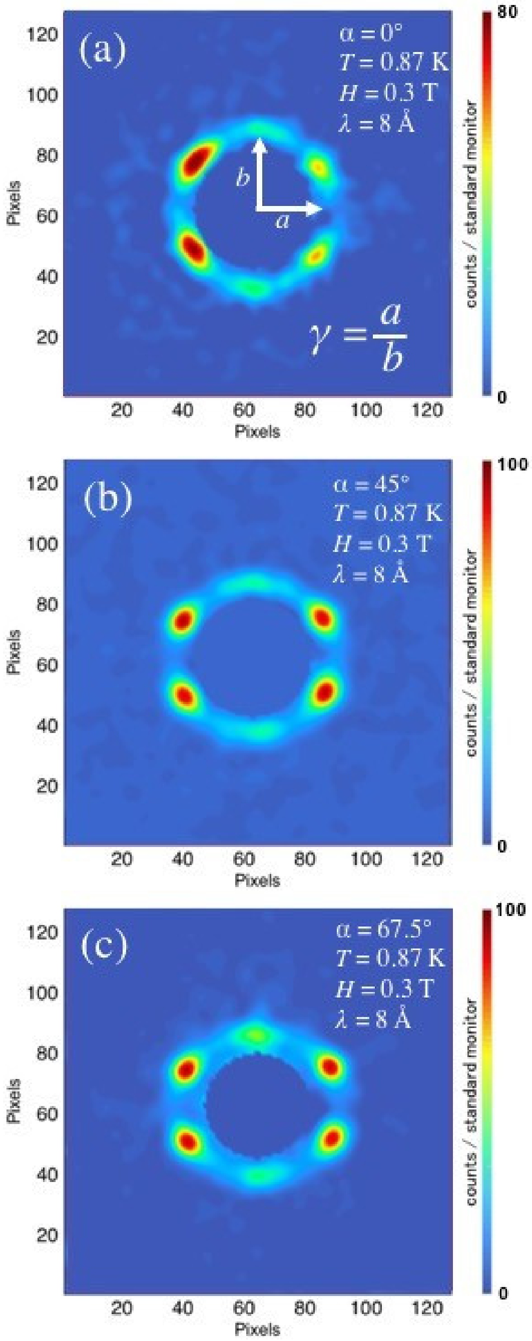

Fig. 1. Fig.1 SANS patterns at α = (a) 0 °(b) 45 °(c) 67.5 °at T = 0.87 K in H =0.3 T.