表題：トポロジカル超伝導体の非弾性散乱

Inelastic neutron scattering experiment on 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.

From fermi surface of β-PdBi2 calculated by first principles[3], we had expected that it has strong nestings. In YNi2B2C, it was reported that a phonon softening, which is interpreted as a Kohn anomaly, due to nesting was found[4]. Accordingly, resonance peaks were observed. In addition, they confirmed that a SC gap opening below Tc and a difference in phonon lifetime between above and below Tc. This result suggested that YNi2B2C was a phonon mediated superconductor. It has a body centered tetragonal structure (space group I4/mmm), same with β-PdBi2.

In order to investigate such behavior in β-PdBi2, we performed inelastic neutron scattering measurements from 10th to 18th August, 2018, at a thermal neutron triple axis spectrometer (HB-1), HFIR in ORNL. For the measurements, we grew single crystals of β-PdBi2 by a melt growth method and Tc of the crystals was evaluated to be Tc = 5.2 K by magnetization measurements. Eleven single crystals of β-PdBi2 (8g in total) were co-alignment on Al plates with scattering plane of (h 0 l). Before the experiment at HB-1, we performed sample alignment at CG-1B, HFIR in ORNL, by using nuclear Bragg reflection of (0 0 -8) and (2 0 0). After that, we set the sample in a CRYO-1 (temperature range is 1.7 K to 300 K) and installed it at HB-1. We measured inelastic signals along the [1 0 0] direction from (0 0 8) and (2 0 0), namely transverse acoustic phonon and longitudinal acoustic phonon. We used constant Ef mode with Ef = 14.7 meV. First, we determined the phonon branches from constant-Q scans with Q = (q 0 8) (q = 0.05 ˜ 0.6) and (2-q 0 0) (q = 0.1 ˜ 0.3) at T = 300 K and 1.5 K. We couldn 't detect clear phonon softening. Next, we performed constant-E scans at several energies at Q = (h 0 8) and (h 0 0), but we couldn 't confirm the existence of the resonance peak. Then, we measured a temperature dependence of scattering intensities at Q = (0.4 0 8), E = 3.2 meV, and Q = (0.3 0 8), E = 1.4 meV, but we couldn 't observe a SC gap opening below Tc. Finally, to confirm the change of phonon lifetime, we performed constant-Q scans with Q = (0.925 0 0) and (± 0.075 0 8). Figs.1(a)(b) show the results of the scans with Q = (0.925 0 0) at (a) T = 1.5K and (b) 10 K. We observed a difference in phonon peak width between T = 1.5 K and 10 K. This suggests a coupling of phonon with the superconductivity.

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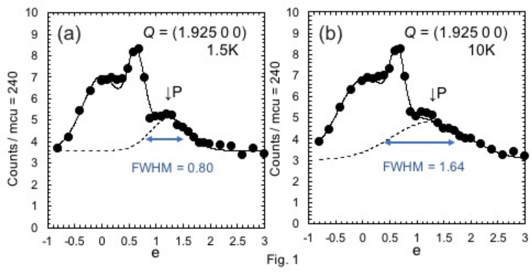

Fig. 1. Constant-Q scan with at (0.925 0 0) at (a) T =1.5 K and (b) 10 K.

使用施設：JRR-3M，装置：4G:GPTAS
分野：Strongly Correlated Electron Systems