Investigation of vortex lattices on non-centrosymmetric superconductor LaNiC2

M. Soda, V. Ryukhtin, P. Strunz, and H. Furukawa
RIKEN, Nuclear Physics Institute, Ochanomizu University,

Non-centrosymmetric superconductor LaNiC2 attracts high interest in last decade due to rather unusual nature of superconductivity. It was supposed that lanthanum atoms participate to Cooper pair creation, because C is non magnetic and Ni magnetic contribution is practically zero [1]. Although, conventional superconductors can only have one spin states (either singlet or triplet) due to Pauli's principle and law of parity conservation, superconductors without inversion symmetry, however, can have a mixed spin states [2]. It was concluded from resistivity measurements at low T that the non-centrosymmetric compound LaNiC2 as a nonmagnetic and weakly-correlated superconductor with two-gap Bardeen-Cooper-Schrieffer.

We have used SANS-1 instrument installed at PSI for vortex lattice (VL) structure of mixed state in LaNiC2 measurements. Magnetic field H was applied along main crystal axes during the measurements. Angular scans were performed at 20 m from sample to detector. Wavelength was set to 12 \AA or 8 \AA depending on magnetic field value.

Structures of VL measured at H = 0.1 T is shown in Fig. 1. The data were collected with scanning over vertical axis by 0.2 degree, summed up, and corrected by background data collected using same scan.

The observed measurements show that vortex structure changes from triangle at H parallel to a-axis (Fig. 1(a)) to square lattice at H//c or H//b (Figs. 1(b) and 1(c)). One can see that VL structure is correlated with positioning of La atoms in orthorhombic cell for corresponded projection. The plane with lanthanum atoms (green spheres in Figs. 1 (d-f)) in triangular symmetry form triangular VL (Fig. 1 (a, d)) as it was measured by H//a. In case of orientations H//b, H//c lanthanum atoms arranged rectangular in plane perpendicular to H (Fig. 1(e), (f)) and resulted VL structures contain four spots.

Temperature dependencies of vortex spot intensities were measured for several magnetic fields in order to study important characteristic of superconductivity: coherence length, penetration depth, full gap/ nodal state and superconducting symmetry. At this moment, we try to analyze the data.

[1] P. Kotsanidis, J. Yakinthos, and E. Gamari-Seale: J. Less-Common Met. 152 (1989) 287.
[2] V.M. Edel'stein: Sov. Phys. JETP68 (1989) 1244.

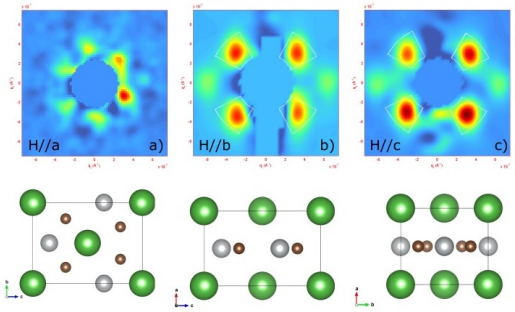

Fig. 1. VL as measured at 1000 Oe with magnetic field applied along main axis of LaNiC2 (a-c) and corresponding projection of crystal (d-f).