MLF Experimental Report

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課題番号 Project No.
2014A0273
実験課題名 Title of experiment
Multipolar excitations in Ce0.7La0.3B6
実験責任者名 Name of principal investigator
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装置名 Name of Instrument/(BL No.)
BL14
実施日 Date of Experiment
2014/12/3-10

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。（適宜、図表添付のこと）
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

Two single crystals of 11B enriched (Ce0.7,La0.3)B6

2. 実験方法及び結果 （実験がうまくいかなかった場合、その理由を記述してください。）

Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

The cubic heavy electron compound CeB6 shows an antiferroquadrupolar (AFQ) order at 3.3 K and an antiferromagnetic (AFM) order at 2.3 K. By doping La into the Ce site, these orders disappear and an antiferrooctupolar (AFO) ordering appears in CexLa1−xB6 for x < 0.8. In order to clarify the low-energy dynamics of 4f electrons in the AFO phase in this La-doped alloy, we carried out inelastic neutron scattering (INS) experiment.

Two cylindrical shaped single crystals of (Ce0.7,La0.3)B6 with a diameter of 4 mm and 5 cm long along the [1,−1,0] direction were grown by the floating-zone method from a 99.46 % isotope-enriched 11B powder. INS experiment was performed at the cold neutron disk chopper spectrometer AMATERAS (BL14). We used multi-incident neutron energy mode with 3.138, 4.685, 7.743 and 15.155 meV. The sample was mounted on the cold plate of a cryogen-free 3He refrigerator with the [1,1,0] and [0,0,1] directions in the horizontal plane and cooled to the lowest temperature 300 mK.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

The wave vector dependence of INS intensity below the AFO transition temperature 1.5 K in (Ce0.7La0.3)B6 was found to be different from those in both the AFQ phase and the AFM phase in the pure CeB6 reported in Ref. [1] and is rather similar to that in the paramagnetic state. Interestingly, INS intensity at the X point (0 0 1/2) in the Brillouin zone is stronger than that at the R point (1/2 1/2 1/2), which is the ordering vector of the AFO phase. This is consistent with our previous INS experiment on powder sample of (Ce0.7La0.3)B6. Figure 1 shows INS spectra at the X point in both the AFO phase and the paramagnetic state. It is clearly seen that the quasi-elastic spectrum in the paramagnetic state (T = 2 K) transforms into the inelastic peak with the energy gap 0.2 meV, which is comparable in magnitude to the transition temperature, in the AFO phase (T = 300 mK) with decreasing temperature. The excitations at the X point may be related to the characteristic Fermi surface topology in rare earth hexaborides, which consists of nearly spherical Fermi surface centered on the X points.

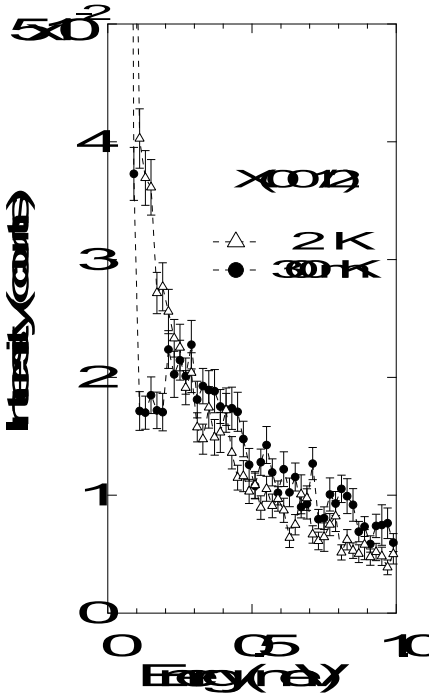

Fig. 1 INS spectra at the X point (0 0 1/2) at T = 300 mK and 2 K.

[1] H. Jang, et al., Nature materials 13 (2014) 682.