

実験報告書様式(一般利用課題・成果公開利用)

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	承認日 Date of Approval 2015/5/28 承認者 Approver Ryoichi Kajimoto 提出日 Date of Report 2015/5/27
課題番号 Project No. 2014B0150 実験課題名 Title of experiment Magnetic excitation of narrow band superconductor FeSe 実験責任者名 Name of principal investigator Shin-ichi Shamoto 所属 Affiliation Japan Atomic Energy Agency	装置責任者 Name of responsible person Ryoichi Kajimoto 装置名 Name of Instrument/(BL No.) 4SEASONS(BL-01) 実施日 Date of Experiment 2015/03/06-11

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.
Single crystals of FeSe

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.
Single crystals of β -FeSe have been grown by the KCl/AlCl ₃ chemical vapour transport method as a direct synthesis method described at ref. 1. The transition temperature, T_c , is about 9 K. Average weight of a single crystal is about 20 mg. In total, about 700 single crystals with the weight of about 2 g are aligned on 9 aluminum plates with 30x50x0.5 mm ³ . β -FeSe phase is known to often have twins due to the iron site vacancy [2]. Because of this nature of β -FeSe crystal, crystal axis direction is widely distributed in the <i>a-b</i> plane. According to our neutron diffraction measurement with $E_i=122$ meV at (3 1 2) Bragg peak, however, the mosaic spread in <i>a-b</i> plane is 7.7 degrees, while that of <i>c</i> -axis is 10.0 degrees. The inelastic neutron scattering measurement has been carried out at 4SEASONS with multi-E _i option with a proton beam power of 300-400 kW. The <i>c</i> -axis of crystals is set to be parallel to the incident beam direction. Incident energies are 474.5 meV and 122.0 meV at 300 Hz chopper rotation. The energy resolutions (FWHM) of $E_i=122$ meV is 10.9 meV at $E=0$ meV. That at $E_i=474.5$ meV is 68 meV at $E=0$ meV, which decreases to 44 meV at $E=170$ meV.

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

The results of $(1,K)/(H,1)$ scans with $E_i=122$ meV at $T=5$ K are shown in Fig. 2. Although there are large background in the scans due to the adhesive glue of crystals on aluminum plates, magnetic excitations are observed as symmetric peaks near $(1,0)$ or $(0,1)$. Spin wave like dispersion was successfully observed even in this non-doped parent material of superconducting FeSe.

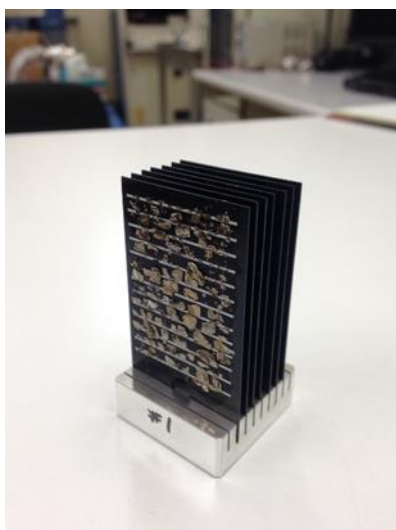


Fig. 1. Aluminum plates with about 700 FeSe crystal pieces.

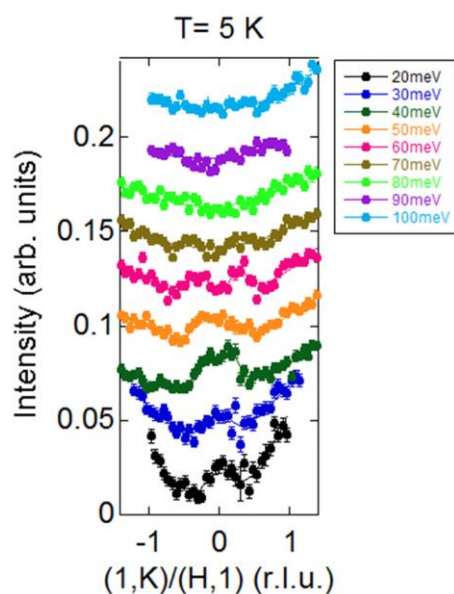


Fig. 2. $(1,K)/(H,1)$ scans with $E_i=122$ meV at $T=5$ K.

References

- [1] A.E. Bohmer, F. Hardy, F. Eilers, D. Ernst, P. Adelman, P. Schweiss, T. Wolf, C. Meingast, Phys. Rev. B 87, 180505(R) (2013).
- [2] Ta-Kun Chen, Chung-Chieh Chang, Hsian-Hong Chang, Ai-Hua Fang, Chih-Han Wang, Wei-Hsiang Chao, Chuan-Ming Tseng, Yung-Chi Lee, Yu-Ruei Wu, Min-Hsueh Wen, Hsin-Yu Tang, Fu-Rong Chen, Ming-Jye Wang, Maw-Kuen Wu, and Dirk Van Dyck, PNAS 2014 111 (1) 63-68.