

課題番号 :2019B-E16  
利用課題名 (日本語) :  
Program Title (English) :Investigation of antiferromagnetic-ferromagnetic transition of GdBaCo<sub>2</sub>O<sub>5.5</sub> thin film by soft X-ray magnetic circular dichroism  
利用者名(日本語) :Yujun Zhang<sup>1)</sup>, 山神光平<sup>2)</sup>, 和達大樹<sup>3)</sup>  
Username (English) :A. Yujun Zhang<sup>1)</sup>, B. Kohei Yamagami<sup>2)</sup>, C. Hiroki Wadati<sup>3)</sup>  
所属名(日本語) :1) Chinese Academy of Sciences, 2) 東京大学物性研究所, 3) 兵庫県立大学理学部  
Affiliation (English) :1) Chinese Academy of Sciences, 2) Institute for Solid State Physics, University of Tokyo, 3) Graduate School of Materials Sciences, University of Hyogo

キーワード :

### 1. 概要 (Summary)

Entanglement of charge, spin, lattice and orbital degrees of freedom in transition metal oxide (TMO) systems have attracted much attention recently [1]. REBaCo<sub>2</sub>O<sub>x</sub> (5<x<6, RE is rare earth element) systems have been intensely investigated [2-4] for their intriguing physical properties such as high oxygen conductivity, metal-insulator transition and spin-state ordering, etc. On the other hand, phase transition with large resistivity change entangled with antiferromagnetic (AFM)-ferromagnetic (FM) transition and spin-state transition were also explored in GdBaCo<sub>2</sub>O<sub>5.5-x</sub> system [4]. Magnetic ordering with an index of (0 0 1/2) was clearly observed. However, systematic investigation of Co moments and spin-states, as well as how they change across the AFM-FM transition (~230 K) is still absent. To achieve this, soft x-ray magnetic circular dichroism (XMCD) characterization is necessary.

### 2. 実験(目的,方法) (Experimental)

We carried out Co L<sub>3,2</sub> edge XMCD measurements for a GdBaCo<sub>2</sub>O<sub>5.5</sub> thin film sample at beamline BL23SU of SPring-8 by a polarization fast switching method, which can greatly improve the data quality of XMCD spectra for further sum-rule analysis. Since the sample has in-plane magnetic anisotropy, a 30°

incidence of X-ray was used. To conduct temperature/field dependent XMCD measurement, high magnetic fields up to 10 T was applied by a superconducting magnet to obtain the AFM-FM boundary in the phase diagram, and a He-flow cryostat was employed to control the sample temperature. Total electron yield was used to detect the absorption signal.

### 3. 結果と考察 (Results and Discussion)

We successfully conducted the temperature/field dependent XMCD measurement at BL23SU of SPring-8. High quality XMCD spectra at various temperatures and magnetic fields were obtained by the polarization fast-switching XMCD technique. Further interpretations, such as sum-rules analysis will be conducted to reveal important information related to the Co moment and spin state GdBaCo<sub>2</sub>O<sub>5.5</sub> in thin film.

### 4. その他・特記事項 (Others)

- [1] E. Dagotto. Science 309: 257-262 (2005).
- [2] T. Katayama, et al. J. Mater. Chem. C 6: 3445 (2018).
- [3] P. Miao, et al. Phys. Rev. B 95: 125123 (2017).
- [4] M. García-Fernández, et al. Phys. Rev. B 78: 054424 (2008).