L-4

Synthesis of BaO thin films by off-axis Pulsed Laser Deposition, and validation assisted electric field

○Hiroaki Miyazawa[1], Shoma Kamada[2], Satoshi Kurumi[3] and Kaoru Suzuki[3,4]

Abstract: In this study, we attempt to remove unwanted oxygen atoms from BaO oxide by electric fields impressed Off-axis PLD on MgO substrate. As a result, XRD profile shows peaks Ba and BaO. Spectra of ablation plumes show difference whether electric fields are impressed. When electric fields were impressed, in cases where wavelength is 553 nm, intensity of emission spectra increased. 553 nm stands for emission spectra of Ba. Therefore this experiment can indicate the effect of electric field.

1. Introduction

Iron type superconductor is being researched by discover of LaFePO (transition temperature (Tc = 4 K)). Characteristics of superconductor are used much low power, and had high response. Superconductors expect new devices instead of semiconductors. However, in order to develop the superconductive devices, it needs high quality source materials. Lattice constants of the superconductor material and the substrate have to match. Additionally, there are same oxidization materials in starting materials for superconductor (La_2O_3, As_2O_3 and BaO etc.) It is require to remove the oxygen atoms from these oxidization material. For removing oxygen atoms, we focused on Off-axis technique. On-axis methods are that substrates are put in front of target bulk. On the other hand, Off-axis methods are that substrates are not put in front of target bulk. Besides, we impressed the electric field between target bulks and substrates. It is expects that positive ions and negative ions are separated by impressing the electric fields. In this study, we attempt to remove oxygen atoms from BaO bulks by electric fields impressed off-axis PLD.

2. Method

Fig. 1 shows experimental apparatus of On-axis PLD and Off-axis PLD. Target bulks for PLD were formed by pressing the BaO powder (ALDRICH, purity: 90 %). Cleaned MgO substrate (10 × 10 × 0.5 mm) and BaO bulks were put in. Anode electrode was set up behind the bulk, and cathode electrode was set up behind the substrate. The chamber was vacuated by vacuumed pump, and Ar gas was flowed in this chamber (10 mtorr). Nd: YAG laser (LOTIS TII, PS-2225M) was irradiated to BaO bulks. (irradiation time: 30 min, energy: 180 mJ, wavelength: 355 nm). Ablation plumes were observed from target bulks by laser irradiation. Electric fields were expressed by applying direct current voltage between anode and cathode. We conducted the experiment for a comparison between On-axis and Off-axis, along with a dependence of the substrate to target bulk spacing in On-axis. Crystalline of BaO films were measured by X-ray diffraction (RIGAKU RINT-2000). We measured emission spectra of ablation plume by spectrometer (StellarNet Inc: EPP2000-UVN-SR-50 wavelength: from 20 mm to 40mm).

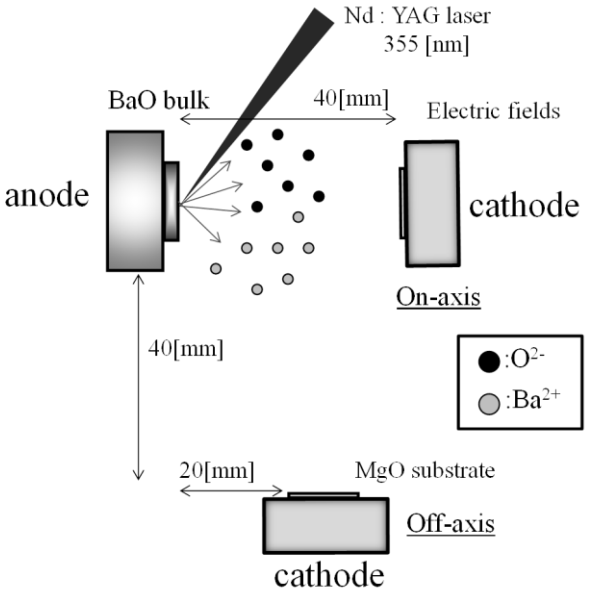

Fig. 1 On-axis PLD and Off-axis PLD

3. Results

Fig. 2 shows XRD spectra of BaO films. The BaO peaks are 34.2, 42.1, and 46.9 deg. And the Ba peaks are 24.6 and 44.7 deg. In the case of on-axis films (40 mm and 20 mm), peaks of Ba and BaO crystal are confirmed. However the profile of off-axis films have no peaks because this system

1:Student Departure of electrical engineering, CST Nihon-U. 2: Graduate student of Electrical Engineering, CST, Nihon-U. 3: Department of Electrical Engineering, CST, Nihon-U. 4: Advanced Materials Science Center and Center for Creative Materials Research.

deposited little the target materials and the deposition films are too thin to occor the diffraction phenomenon. As compared to 40 mm and 20 mm films, peaks intensity were similar in spite of distance between laser target and substrate were far. In cases where 40 mm, ablation plumes were deposited through the distance between the substrate and target bulk is so far .

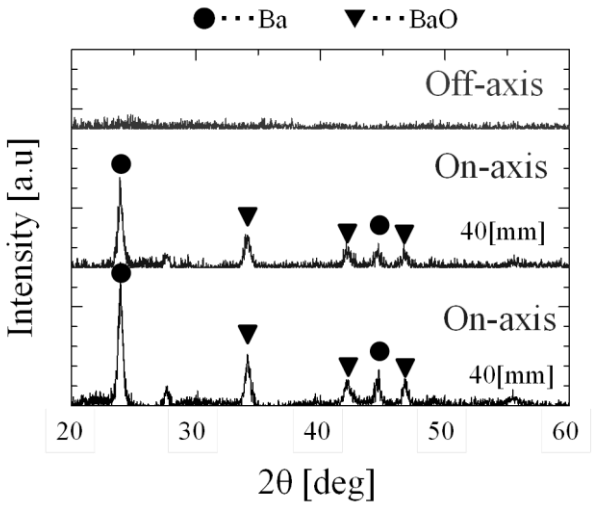

Fig. 2 XRD spectra of BaO films

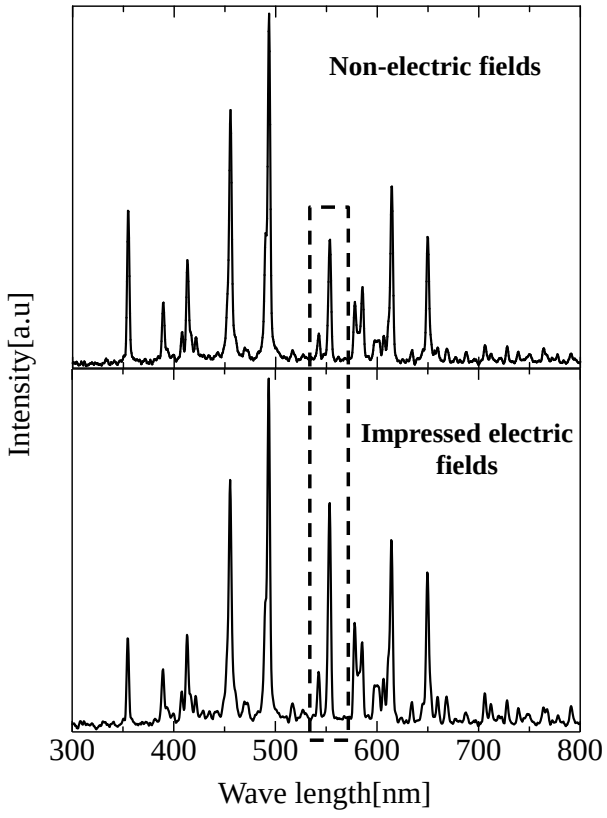

Fig. 3 ablation plumes Emission spectra (BaO)

Fig. 3 shows emission spectra of ablation plume from BaO bulks by YAG laser irradiation. The ablation plumes emission peaks occure at 355, 389, 413, 455, 493, 553, 585, 614 and 649 nm. A peak of 355 nm means emission due to YAG laser wavelength. The other peaks were due to the Ba emission. [7] A peak of 553 nm at condition of electric impressed fields was higher than that of non-electric fields. However, the peaks which emit from oxygen atoms or ions were not observed.

4. Conclusion

As for a measure of emission spectra, a difference is indicated by electric field. By ascending Ba peaks, distribution of Ba slanted in ablation plume. We coudn't obtain acceptable crystalline by XRD.We need to investigate difference of deposition in another way. For example chemical structure of substance can be observed by raman spectrometric method, and the surface of deposited a film can be wxamed by scanning electron microscopy (SEM). We couldn't visually look see a difference of ablation plume, which could be considered a cause that electric field was too small. However voltage is so high that electric pole discharge an electric current. Therefore we need to reconsider the effect of ambient pressure on electric field.

5. Reference

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