$Ba_{1/3}CoO_2$ エピタキシャル薄膜の熱電特性の温度依存性

Temperature Dependence of Thermoelectric Properties of $Ba_{1/3}CoO_2$ Epitaxial Films

北大電子研 [1], 北大院情報 [2] ○張 雨橋 [1], 高嶋 佑伍[2], 呉 礼奥 [2], ジョ ヘジュン [1,2], 太田 裕道 [1,2]

RIES [1], IST [2] Hokkaido Univ., ○Y. Zhang[1], Y. Takashima[2], L. Wu[2], H.J. Cho[1,2], and H. Ohta[1,2]

E-mail: yuqiaozhang0730@gmail.com

Last October, we reported that a layered cobalt oxide, $Ba_{1/3}CoO_2$ shows thermoelectric figure of merit ZT = 0.11 at room temperature.[1] This value is the highest among oxide-based thermoelectric materials ever reported as a "reliable value". In this presentation, we show that the ZT increases up to 0.2 at 200 °C in air.

We fabricated $Ba_{1/3}CoO_2$ epitaxial films on sapphire or YSZ substrate by the reactive solid phase epitaxy[2] followed by the ion exchange method[1]. Note that the crystal structure of $Ba_{1/3}CoO_2$ is composed of CoO_2 and Ba layers alternately stacked along the c-axis. The thermoelectric properties were measure parallel to the CoO_2 layer.

Figure summarizes the thermoelectric properties of the resultant $Ba_{1/3}CoO_2$ epitaxial film at several temperatures in air. The thermopower (**Fig. a**) slightly increased and the electrical conductivity (**Fig. b**) gradually decreased with increasing temperature. We observed hydrated phase disappeared when the film was heated at 100 °C. We guess that the increase of the electrical conductivity (RT − 50 °C) is due to the decomposition of the hydrated phase. The resultant power factor gradually decreased with temperature (**Fig. c**). The thermal conductivity parallel to the CoO_2 layer was extracted from the thermal conductivity of c-axis oriented and c-axis inclined film. The thermal conductivity slightly decreased with temperature (**Fig. d**). The resultant ZT reached 0.2 at 200 °C (**Fig. e**).

In addition, we have clarified that $Ba_{1/3}CoO_2$ epitaxial films show excellent thermal stability at high temperature (800 °C) in air. The present result clearly indicates that $Ba_{1/3}CoO_2$ shows rather large ZT at high temperature in air.

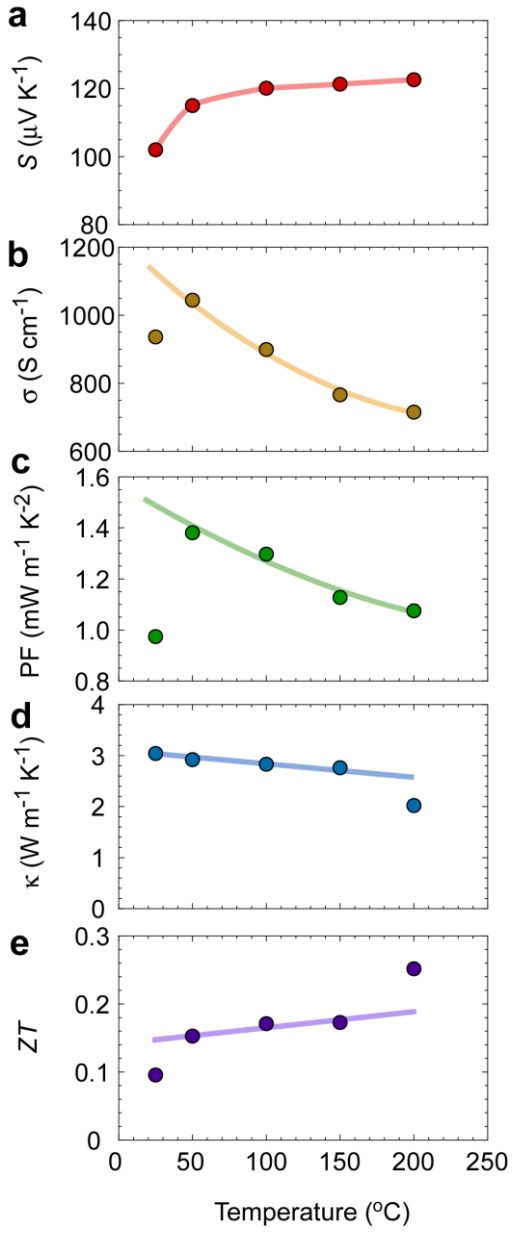

Figure Thermoelectric properties of the $Ba_{1/3}CoO_2$ epitaxial film at several temperatures. (a) Thermopower, S, (b) electrical conductivity, σ, (c) power factor, PF, (d) thermal conductivity, κ, (e) ZT

References

[1] Y. Takashima *et al.*, *J. Mater. Chem. A* (2020). (DOI: 10.1039/D0TA07565E)

[2] H. Ohta *et al.*, *Cryst. Growth Des.* **5**, 25 (2005).