(Ba, Sr)TiO_3セラミックスの電気熱量効果

Electrocaloric Effects of (Ba,Sr)TiO_3 Ceramics

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The electrocaloric effect (ECE) is considered to be one of the new cooling mechanisms. By using ECE, the application to compact a high energy-effective, inexpensive, and safe refrigerator would be considered. In order to create ECE cooling devices, materials with large ECEs are required. For direct measurement of the ΔT, there are some difficulties. Most temperature changes are less than 1K. And heat dissipation from ferroelectric materials through electrode, wire, and/or the supporting jig for field application occurs. Most probably due to these difficulties, the reports on the direct measurement of ΔT are limited thus far. In this study, the electrocaloric temperature change, ΔT, due to applied ΔE, of the $BaTiO_3$ ceramics is estimated and directly measured. Electrocaloric properties were investigated by indirect estimation and direct measurement of temperature–electric field (T–E) hysteresis loops. The measured T-E loops showed a similar shape to strain–electric field (s–E) loops. The measured temperature changes ΔT of the (Ba,Sr),TiO_3 (BST) ceramics sintered at 1600°C upon the release of the electric field from 30 kV/cm to zero was 0.57K at 30°C. The temperature dependences of the electromechanical and electrocaloric properties were investigated. Fig. 1 shows T-E loops from the (Ba,Sr)TiO_3 ceramics. BST is more temperature dependent compared with Ba(Zr,Ti)O_3 (BZT). BST ceramics sintered at 1600°C exhibited the largest the electromechanical and electrocaloric properties at around 30°C. This temperature corresponds to the temperature around 10°C higher than the phase transition temperature.

This study is partly supported by grant from KAKENHI #26420684, from the Ministry of Education, Culture, Sports, Science and Technology.

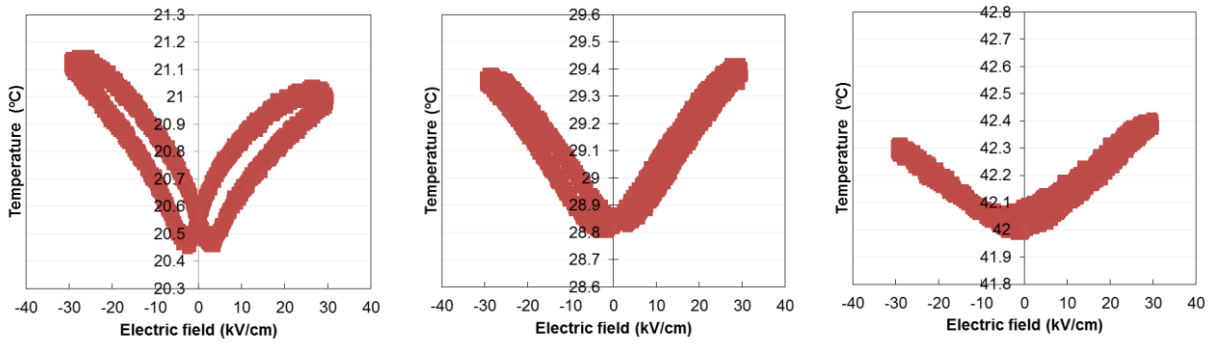

Fig. 1. Temperature-electric field (T-E) loops of the (Ba,Sr),TiO_3 ceramics.

References

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