$K(Ta,Nb)O_3$結晶、$BaTiO_3$系セラミックスの電気熱量効果（Ⅱ）

Electrocaloric Properties of $K(Ta,Nb)O_3$ Crystals and $BaTiO_3$-based Ceramics(II)

湘南工大工[1]　○眞岩 宏司[1]

Shonan Inst. Tech.[1] ○Hiroshi Maiwa[1]

E-mail: maiwa@mate.shonan-it.ac.jp

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 $K(Ta,Nb)O_3$ crystal and $BaTiO_3$ ceramics is estimated and directly measured. Electrocaloric properties of Potassium Tantalate Niobate (KTN) crystals 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 adiabatic temperature change ΔT due to electrocaloric effects was estimated to be 0.49 K under a field of 20 kV/cm from the polarization change of the sample. The measured temperature changes ΔTs in these sample upon the release of the electric field from 20 kV/cm to zero were 0.42 K. Temperature dependent of electromechanical and electrocaloric properties were also measured. The maximum performance was appeared at around phase transition temperature and the properties was relatively mild temperature dependent. Fig. 1 shows T-E loops from the doped $BaTiO_3$ ceramics. ΔTs of 0.2-0.3K were measured in these samples.

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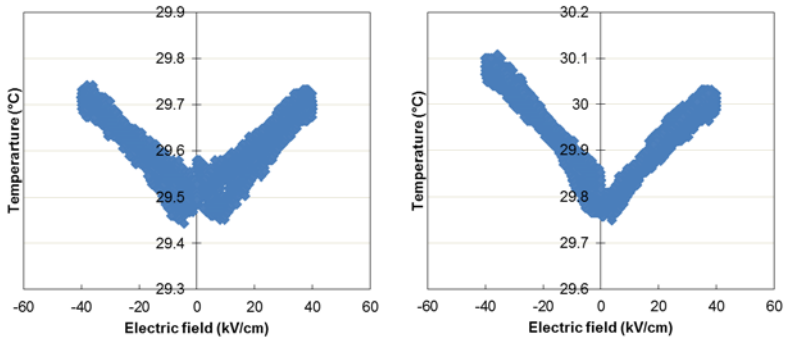

Fig. 1. Temperature-electric field (T-E) loops of the $BaTiO_3$-based ceramics.