

## High $T_c$ Pb-free $(1-x)\text{BaTiO}_3-x(\text{Bi}_{1/2}\text{Na}_{1/2})\text{TiO}_3$ 세라믹의 미세구조와 PTCR 특성

김 철민, 조 용수, 정 영훈, 이 영진, 이 미재, 백 종후, 이 우영, 김 대준  
요업(세라믹)기술원, 연세대학교, (주)하이델.

### Microstructure and PTCR characteristic of high $T_c$ lead-free $(1-x)\text{BaTiO}_3-x(\text{Bi}_{1/2}\text{Na}_{1/2})\text{TiO}_3$ characteristic

Chul-Min Kim, Yong-Soo Cho, Young-Hun Jeong, Mi-Jae Lee, Jong-Hoo Paik, Woo-Young Lee and Dae-Joon Kim  
Korea Institute of Ceramic ENG. & TECH, Yonsei University, and HIEL co.

**Abstract** : Microstructure and positive temperature coefficient of resistivity (PTCR) characteristics of  $0.9\text{BaTiO}_3-0.1(\text{Bi}_{0.5}\text{Na}_{0.5})\text{TiO}_3$  [BaBiNT] ceramics doped with  $\text{Nb}_2\text{O}_5$  were investigated in order to develop the Pb-free high Curie temperature ( $T_c$ )(>160°C) PTC thermistor. The BaBiNT ceramics showed a tetragonal perovskite structure, irrespective of the added amount of  $\text{Nb}_2\text{O}_5$ . They also have a homogeneous microstructure. The resistivity of BaBiNT ceramics was gradually decreased by doping  $\text{Nb}_2\text{O}_5$ , which might be due to  $\text{Nb}^{+5}$  ions substituting for  $\text{Ti}^{+4}$  sites. The PTCR characteristics of BaBiNT ceramics appeared when the amount of doped  $\text{Nb}_2\text{O}_5$  exceeded 0.0025mol%. Moreover, the abrupt grain growth was observed for the 0.03mol%  $\text{Nb}_2\text{O}_5$  added BaBiNT ceramics. It showed an especially high  $T_c$  of approximately 172°C and good PTCR characteristics of a high  $\rho_{\text{max}}/\rho_{\text{min}}$  ratio ( $2.96 \times 10^3$ ), a high resistivity temperature factor (11.4%/°C) along with a relatively low resistivity ( $3.5 \times 10^{-4} \Omega \cdot \text{cm}$ ).

**Key Words** : positive temperature coefficient of resistivity, Curie temperature, tetragonal perovskite structure