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

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

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Abstract: Microstructure and positive temperature coefficient of resistivity (PTCR) characteristics of 0.9BaTiO$_3$-0.1(Bi$_{1/2}$Na$_{1/2}$)TiO$_3$ [BaBiNT] ceramics doped with Nb$_2$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 Nb$_2$O$_5$. They also have a homogeneous microstructure. The resistivity of BaBiNT ceramics was gradually decreased by doping Nb$_2$O$_5$, which might be due to Nb$^{5+}$ ions substituting for Ti$^{4+}$ sites. The PTCR characteristics of BaBiNT ceramics appeared when the amount of doped Nb$_2$O$_5$ exceeded 0.0025mol%. Moreover, the abrupt grain growth was observed for the 0.03mol% Nb$_2$O$_5$ added BaBiNT ceramics. It showed an especially high $T_c$ of approximately 172°C and good PTCR characteristics of a high $\rho_{max}/\rho_{min}$ ratio (2.96×10$^4$), a high resistivity temperature factor (11.4%/°C) along with a relatively low resistivity (3.5 ×10$^4$Ω • cm).

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