Sintering and Dielectric Study of $Na_{0.9}K_{0.1}(Nb_{0.9}Mg_{0.1})O_{2.7}F_{0.3}$ Ferroelectric Ceramics

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Dielectric ceramics ABO_3 have numerous properties and are very attractive due to their applications as capacitors, sensors, actuators, resonators, optical memories in many devices. Among these materials, sodium niobate ($NaNbO_3$) is known as a typical antiferroelectric which undergoes six (6) phase transitions. At room temperature, this perovskite crystallizes in an orthorhombic symmetry. Moreover, it was demonstrated that small additives of $KNbO_3$, $CdNbO_3$, $LiNbO_3$, $PbNbO_3$, $PbTiO_3$, $PbZrO_3$ or $CaTiO_3$ to $NaNbO_3$ induce ferroelectricity in the solid solutions obtained. In previous works, we investigated the chemical systems $NaNbO_3 – AMgF_3$ (A = Na, K) and two solid solutions with general formula $Na_{1-x}A_x(Nb_{1-x}Mg_x)O_{3-3x}F_{3x}$ were obtained [1, 2]. The present study reports the dielectric properties of $Na_{0.9}K_{0.1}(Nb_{0.9}Mg_{0.1})O_{2.7}F_{0.3}$ ceramics. $NaNbO_3$ and $KMgF_3$ are previously prepared at respectively 900 °C and 700 °C. $Na_{0.9}K_{0.1}(Nb_{0.9}Mg_{0.1})O_{2.7}F_{0.3}$ ceramics are then elaborated by sintering at various temperatures (900 °C ≤ $t_{sint.}$ ≤ 1100 °C) during different holding times (2 h ≤ $\theta_{sint.}$ ≤ 15 h). Dielectric measurements are carried out from room temperature up to 500 °C in a large frequency range ($10^2 – 10^9$ Hz). At low frequencies, the samples exhibit only one second order phase transition. The dielectric permittivity ε'_r reaches 6400 whereas a minimum of 0.9 is observed for the dielectric losses at the Curie temperature $T_C \approx 270$ °C. The unique phase transition is confirmed by an X-ray diffraction analysis performed as a function of temperature. In the gigahertz region, the curves ε'_r – log f and ε''_r - log f display a resonance phenomenon. As a result, the $Na_{0.9}K_{0.1}(Nb_{0.9}Mg_{0.1})O_{2.7}F_{0.3}$ oxifluoride could be a promising material to manufacture electronic components for various devices operating in the microwave region.

[1] Z. Ladjeroud, L. Benziada and J.Ravez, The Eighth International Meeting on Ferroelectricity (IMF8), Gaithersburg, Maryland, USA, August 8-13 (1993).
[2] Z. Ladjeroud, L. Benziada and J. Ravez, Ferroelectrics, 154, 207 (1994).

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