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p-type/*n*-type behaviour and functional properties of $K_xNa_{(1-x)}NbO_3$ ($0.49 \leq x \leq 0.51$) sintered in air and N_2

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Abstract

Potassium sodium niobate (KNN) is a potential candidate to replace lead zirconate titanate in sensor and actuator applications but there are many fundamental science and materials processing issues to be understood before it can be used commercially, including the influence of composition and processing atmosphere on the conduction mechanisms and functional properties. Consequently, KNN pellets with different K/Na ratios were sintered to 95% relative density in air and N_2 using a conventional mixed oxide route. Oxygen vacancies ($V_O^{\bullet\bullet}$) played a major role in the semi-conduction mechanism in low $p(O_2)$ for all compositions. Impedance spectroscopy and thermo-power data confirmed KNN to be n-type in low $p(O_2)$ in contradiction to previous reports of p-type behaviour. The best piezoelectric properties were observed for air- rather than N_2-sintered samples with d_{33}=125 pC/N and k_p=0.38 obtained for $K_{0.51}Na_{0.49}NbO_3$.

Keywords: *p*-type, *n*-type, low $p(O_2)$, oxygen vacancies, Seebeck coefficient