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Properties of KNN ceramics of different phase composition

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In this paper we studied the structure and properties of sodium-potassium niobate ceramics (KNN). It was produced using two different technologies. As a result ceramics has a different phase composition.

The raw materials for the synthesis were potassium and sodium carbonates and niobium pentoxide. KNN ceramics were synthesized by the conventional solid state reaction method. In the first case, all three raw components were mixed in specified proportions. In the second case, sodium and potassium niobates were synthesized first. Then KNN ceramics were prepared by mixing $NaNbO_3$ and $KNbO_3$. According to X-ray phase analysis in the first case, the main phase is $K_{0.3}Na_{0.7}NbO_3$, in the second – $K_{0.44}Na_{0.56}NbO_3$.

The ceramics structure was studied by the method of atomic force microscopy (AFM). The ceramics produced by the first method has a grain size larger (2 – 4 μm), than the ceramics produced by the second method (500 nm – 2 μm). Accordingly, the size of domains is also different. The size of domains decreases with decreasing grain size. Despite the fact that the ceramics have a different phase composition, their symmetry (orthorhombic) at room temperature, according to the phase diagram [1], is the same. Thus, the types of the domain structure also coincide (Fig.1). This is a periodic strip domain structure.

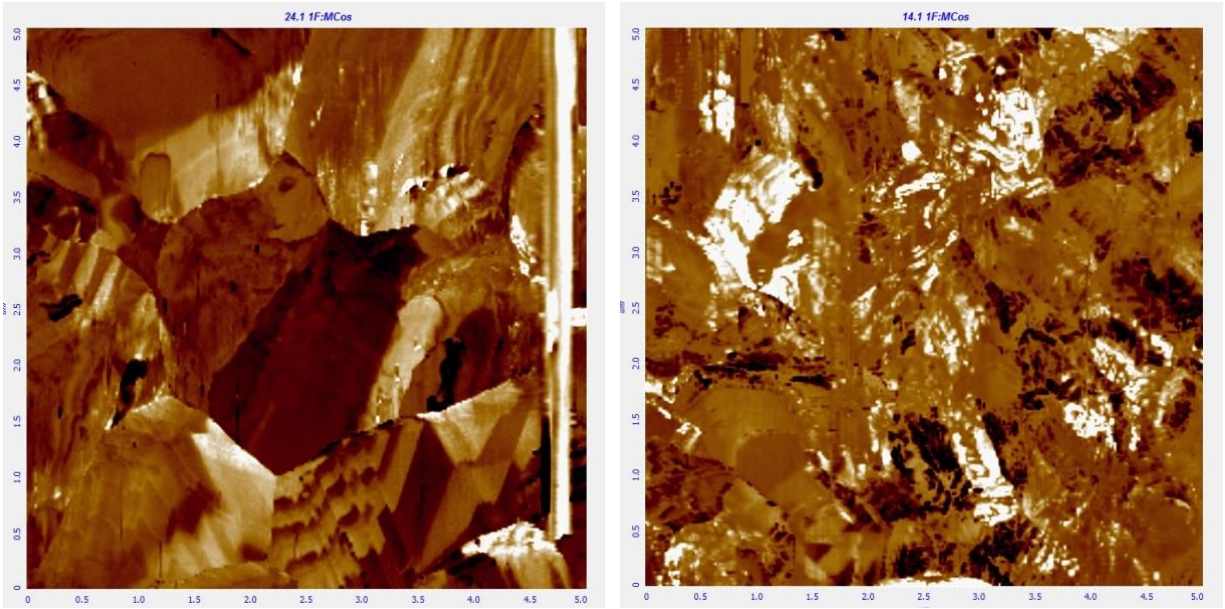

Figure 1. PFM response of ceramics (a) $K_{0.3}Na_{0.7}NbO_3$ and (b) $K_{0.44}Na_{0.56}NbO_3$.

Despite this, the macroscopic properties of these materials, such as the polarization switching, the width of the diffuse phase transition and pyroelectric response, are different. Therefore, the local ferroelectric properties of ceramics were studied using AFM: the properties of domain walls, local polarization switching.

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1. M. Ahtee, A.M. Glazer, *Acta Cryst. Sec. A: Found.of Cryst*. **32**, 434 (1976).