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Sintering Process and Characterization by Atomic Force Microscopy of Nanophase $KSr_2Nb_5O_{15}$ – $CuO:B_2O_3$

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Abstract – $KSr_2Nb_5O_{15}$ (KSN) is a ferroelectric oxide with tetragonal tungsten bronze structure (TTB). KSN ceramic doped with $CuO:B_2O_3$ rations were prepared by a conventional ceramic route and the surface topographies of these systems were investigated by AFM. KSN ceramic has a porous microstructure and AFM images showed grains with distinct morphologies in which the extremities are higher when compared with the grain center. $KSr_2Nb_5O_{15}$ – $CuO:B_2O_3$ ceramic systems are denser than the pure ceramic and nanophases at the grain boundaries, twined grains and grains constituted of small crystallites were observed in the AFM images.

Strontium and potassium niobate (KSN) is a ferroelectric oxide with tetragonal tungsten bronze structure (TTB). This type of structure allows the manufactured of multiferroic materials, in which magnetism and ferroelectricity are strongly coupled [1]. The objective of this work was to investigate the surface morphology of the KSN – $CuO:B_2O_3$ ceramic systems by AFM. The powder precursor of KSN was synthesized by oxide mixture in a high-energy ball mill. The manufacture process of the ceramic systems is the same as described elsewhere [2]. $CuO:B_2O_3$ rations were used as promoters of sintering process of the KSN ceramic. The topographical analyses of the surfaces were acquired in an atomic force microscope (Shimatzu SPM 9500) in intermittent mode and constant force. The microstructure KSN ceramic is typical of intermediate stage of sintering process. The doped materials with different $CuO:B_2O_3$ rations are denser than the KSN ceramic. Nevertheless, the density of the doped materials decreased due to the increase of B_2O_3 amount. AFM image of the KSN ceramic (Figure 1) revealed the formation of a porous microstructure and grains with distinct morphologies. AFM image of the surface of the KSN – $CuO:B_2O_3$ ceramic shows that these ceramics have a morphology different in comparison with the pure ceramic. Nucleation of nanophases at the grain boundaries, twined grains were observed in the AFM images and the lamellar structures are in the order of nanometers (width ~ 0.1 μm and height ~ 2 nm). The formation of lamellar grains is an intrinsic characteristic of ferroelectric ceramics [3]. Another AFM images revealed that some grains are constituted of several crystallites. The X-rays diffraction results of the several investigated ceramic systems also will be presented.

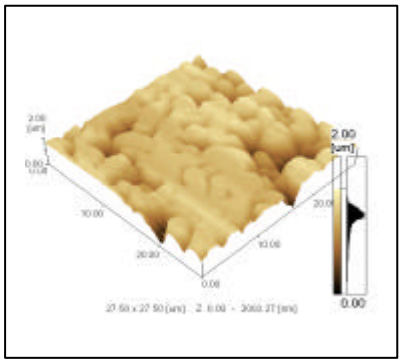

Figure 1: AFM image of KSN ceramic sinterized at 1200 °C.

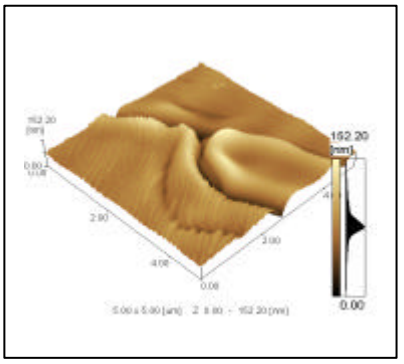

Figure 2: AFM Image of KSN – $CuO:B_2O_3$ ceramic system sinterized at 1200 °C, $CuO:B_2O_3$ ration = 1:4.

References

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