Characterization of $KNbO_3$ Piezoelectric Thin Films by Hydrothermal Method

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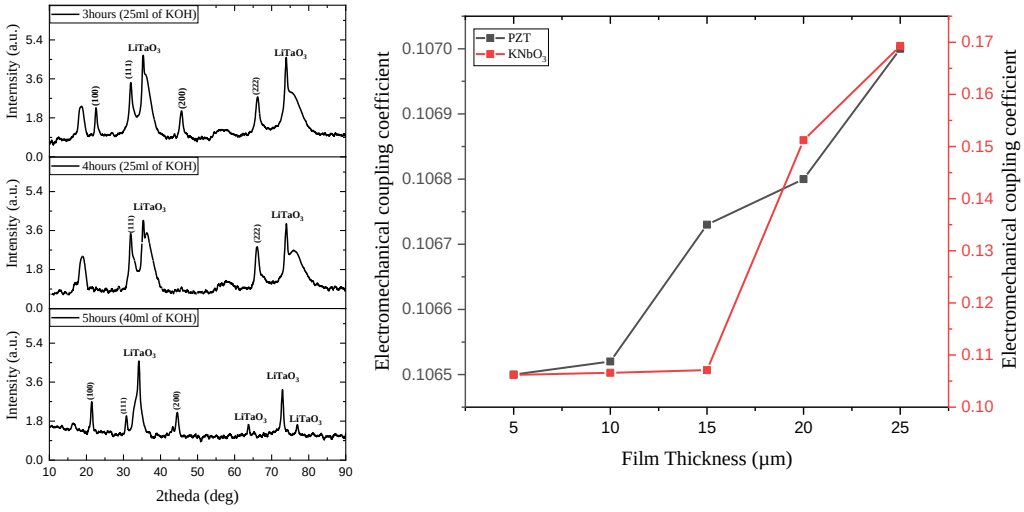
Abstract

Piezoelectric thin films with perovskite structure are in focus as lead- free piezoelectric material to reduce the environmental damage and hazard. In this research, $KNbO_3$ films were synthesized on single crystal $LiTaO_3$ substrate by hydrothermal method at 240°C at different reaction time. Linear two-dimensional finite element method (2D-FEM) was used to estimate the values of electromechanical coupling coefficient (k_t) with different film thickness.

Figure 1 shows the XRD results of crystal structures of the obtained films at 3hr, 4hr and 5hr reaction time. Diffraction peaks correspond respectively to the (100), (111), (200) and (222) planes of an orthorhombic structure of standard $KNbO_3$. When KOH value changed from 25ml to 40ml at 5hr results decreased in substrate $LiTaO_3$ peak intensity compare to 3 &4 hr. Figure 2 shows simulation results of electromechanical coupling coefficient k_{31} according to $KNbO_3$ film thickness. K_{31} increase with increasing film thickness and at 25 μ m, k_{31} = 0.169 (16.9%). Simulation results of PZT at thickness 25 μ m, k_{31}=0.107 (10.7%). Simulation results show $KNbO_3$ can be a good candidate to replace PZT by controlling film thickness.



(1) (2)

Fig.1. X-ray diffractometer (XRD) patterns of $KNbO_3$ films for reaction times 3 hours, 4 hours, and 5 hours. Fig.2. Film thickness dependency of k_{31} estimated by FEMTET software