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Ultrasonic Velocity in Potassium Sodium Tantalate Mixed System

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ABSTRACT

Ultrasonic velocity in the ceramic pellets of material $K_{1-x}Na_xTaO_3$ (X=0, 0.2, 0.3, 0.4, 0.5, 0.6 & 1) have been investigated at temperature 320C and frequency 5MHz with the help of Ultrasonic c-scan system developed at NPL, New Delhi. The samples have been prepared by the conventional solid-state reaction method and sintering process.
Keyword: Ultrasonic Velocity, NPL, Potassium Sodium Tantalate, PST

I. INTRODUCTION

Ultrasonic testing of materials is one of the widely used methods of nondestructive testing, in which beams of high frequency sound waves generally 0.5 MHz to 25 MHz are used to detect the cracks, laminations, shrinkages, cavities and other discontinuities. Inclusion and other inhomogeneties in the material can also be detected using partial reflection or scattering of ultrasonic waves. It has high sensitivity for detecting flaws, can penetrate extremely thick sections and need access to only one surface of the testing material. We have measured the Acoustical velocity in potassium sodium tantalate mixed ceramics at 32^0C and at frequency 5 MHz.

The propagation of ultrasonic wave in any substance has become a fundamental test to investigate its properties. The velocity and attenuation coefficients are the basic propagation constants, which are related to the microscopic structure of the materials. Potassium Sodium Tantalate (PSN) with perovskite structures are widely used for transducer applications with broad ranges of technologically important dielectric, piezoelectric, ferroelectric and electro-optic properties. Cross [1] has predicted, theoretically, the phase diagram of $KTaO_3$-$NaTaO_3$ mixture from phenomenological arguments. Due to the immense importance of these materials, Acoustical investigation has been carried out by several researchers [2-8]. Preparation of amorphous and nano crystalline Sodium Tantalate Oxide photocatalysts with porous matrix structure for overall water has been investigated by Harun Tuysuz et.al. [9]. Microstructure of Sodium - Potassium niobate ceramics sintered under high alkaline vapour pressure atmosphere has been studied by Jerome Acker et.al.[10]. Fast synthesis of $NaNbO_3$ and $Na_{0.5}K_{0.5}NbO_3$ by microwave hydrothermal method was performed by Rigoberto Lopez-Juarez et.al.[11]. Synthesis, photo physical properties, and photo catalytic applications of Bi doped $NaTaO_3$ and Bi doped Na_2TaO_3 nano particles was studied by Pushkar Kanhere et.al.[12]. Theoretical & experimental studies on Ceramic Samples of different ferroelectric material has been done to understand the salient features as these materials [13-17]

II. METHODS AND MATERIAL

A. Preparation

The raw materials used for preparing the compositions from this system were sodium carbonate, potassium carbonate and niobium pentaoxide. The starting material was dried at 200^0C for one hour to remove absorbed moisture. Different compositions of $K_{1-x}Na_xTaO_3$ for (x=0, 0.2, 0.3, 0.4, 0.5, 0.6 & 1) were prepared by weighing the sodium carbonate, potassium carbonate and niobium pentaoxide. The mixture was calcined in the platinum crucible, in air, at 950^0C for 2h for carbonate removal. The pre-sintered mixture was ground and pressed into pellets of 10mm diameter. All the

pellets were placed on a platinum crucible and sintered, in air, at 1050^0C for 26 h.

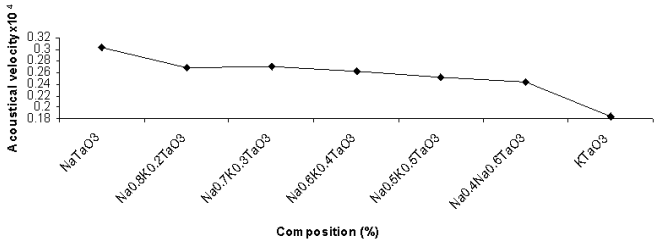
B. Measurement

In the present study we have investigated the ultrasonic velocity in pure and mixed system of $Na_{1-x}K_xTaO_3$ where (x=0, 0.2, 0.3, 0.4, 0.5, 0.6 &1).The velocity has been measured at the transverse section of the prepared samples at frequency 5 MHz and at temperature 32^0C with the help of Ultrasonic c-scan system developed at NPL, New Delhi. Variation of Acoustical velocity by mixing K on $NaTaO_3$ is tabulated in table 1 and figure 1.

Table 1

Sample ($Na_{1-x}K_xTaO_3$) (x=0,0.2,0.3,0.4,0.5,0.6 &1)	**Acoustical velocity $x10^4$ m/s**
$NaTaO_3$	0.3026
$Na_{0.8}K_{0.2}TaO_3$	0.2679
$Na_{0.7}K_{0.3}TaO_3$	0.2701
$Na_{0.6}K_{0.4}TaO_3$	0.2626
$Na_{0.5}K_{0.5}TaO_3$	0.2526
$Na_{0.4}Na_{0.6}TaO_3$	0.2448
$KTaO_3$	0.1838

Fig.1 Variation of acoustical velocity by mixing K in $NaTaO_3$



III. RESULT AND DISCUSSION

The study of the prepared samples aimed at understanding the Acoustical velocity and mechanism that could lead of the present PST system. From above figure 1, it is observed that as soon as potassium is mixed with sodium tantalate at temperature 32^0C and frequency 5 MHz i.e., K on $Na_x K_{1-x} TaO_3$, the ultrasonic velocity decreases continuously.

IV. ACKNOWLEDGEMENT

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