ELECTRICAL CHARACTERIZATION OF LEAD NIOBIUM ZIRCONATE TITANATE (PNZT) FOR ELECTRONIC APPLICATION

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ABSTRACT

Lead niobium zirconate titanate (PNZT) is a PZT thin film with Nb doped. This paper proposes an electrical characterization of PNZT for electronic application. The work will involve with the electrical experimentation using PNZT as a sample. An electrical characterization of PNZT is performed to measure the current-voltage (I-V), resistivity and dielectric to examine PNZT as a potential candidate for sensor application. The resistivity and conductivity for PNZT coated with Pt are 132n Ωm and 7.58 x 10^6 Ωm^{-1} respectively. The resistivity of PNZT is unavailable due to its high resistivity. The dielectric constant of PNZT is decreased as frequency increased. It proven that PNZT are suitable in low frequency device due to its high resistance. The dielectric loss of PNZT is decreased as frequency increased. This is due to ionic behavior of PNZT. The conductivity increases as the frequency increases. It shows that, PNZT is capable to be used in the higher frequency electronic devices due to higher conductivity. Results of structural behavioral properties show that the surface of PNZT is rougher as compared to the PNZT coated with Pt. A simulation with LT-Spice has shown that the electrical properties of PNZT are suitable for the pyroelectric/piezoelectric sensor by using a PNZT as capacitor model.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW OF PNZT

In recent years, PZT thin films can be used in many applications in various fields such as ferroelectric nonvolatile random access memories (FeRAM), infrared sensors, piezoelectric micro-actuators and micro electromechanical systems (MEMS). Platinized silicon is a conventional substrate for the micro fabrication of MEMS devices and much work has been done to develop high-performance PZT films on silicon substrates. However, the PZT films deposited on platinized silicon substrate tend to crystallize polycrystalline films with complicated grain orientations and exhibit weak spontaneous and piezoelectric response which leads to difficulties in yielding the desired properties. One effective ways to resolve this problem is to fabricate thin films with a preferential crystallographic. Several studies found that the PZT thin films posing the <111> orientations have better ferroelectric and dielectric properties. Whereas the <100> orientation of PZT thin films provide an enhanced piezoelectric response which both orientations are preferred compared to the random orientation [1, 2].