ABSTRACT

Lead Zirconate Titanate (PZT) thin film is a perovskite material of sublime ferroelectric, piezoelectric, dielectric, mechanical, optical and pyroelectric properties. According to the chemistry of materials, the perovskite ceramics provide an astounding list of structures and related phases that function based on the behavior of cations present in them.

Lead based perovskites show interesting magnetic properties. PZT devices have high bandwidth, sensitivity. Due to these advantages, they can be used in memory devices medical diagnostic tools, surgical tools, minute body implants.

In spite of ample attempts to study the growth, characteristics and applications of PZT a clear picture in terms of the relation between growth conditions and application areas remains an area to be still concentrated. This picture is expected to be in terms of simple and cost effective techniques to be adopted expecting high performance devices.

In view of it, the major task of the present investigation is to focus on the behavior of temperature of the solution and substrate in perspective of the characteristics of PZT thin films. A literature review on PZT thin films gives an idea that the magnetic properties of pure PZT are seldom concentrated. Thus this study makes an attempt to study the magnetism in pure PZT, forecasting the multiferroic behaviour of PZT.

An easy sol-gel spin coating method is adopted to coat the films, which is easily scalable to industry requirements. The important findings regarding PZT were reported on alumina and quartz substrates based on solution temperature.

At the present research, the pure PZT thin films are spin coated on to alumina and quartz substrates with varied sol temperature. The choice of the substrate for PZT thin film deposition is pivotal as it affects the physical properties of the final deposit due to the presence of cracks and density of the film.

The present substrates were selected in view of literature, annealing temperature to be applied for final crystallization of films into perovskite structure and characterization techniques to be used.

The X-ray patterns were used to confirm the perovskite structure formation, calculate the structural parameters related to films. The structure and thickness of the films were observed with the help of High Resolution Scanning Electron Microscopy (HRSEM). Micro and nano meter thickness were found from a cross-sectional view of samples. The optical band gap found from UV-Visible spectroscopy reveal grain size and substrate dependent values. Photoluminescence studies show the quality of films and observed spectra reveal the presence of oxygen vacancies in the present films.

To know the magnetic behaviour of PZT thin films, the magnetic measurements were performed at room temperature (RT) using vibrating sample magnetometer. When the PZT films exhibited room temperature ferromagnetism at low applied fields on an alumina substrate, which is serendipity of study, an attempt is made to confirm this behaviour removing the effect of the substrate.

In this regard, the gel is made to PZT powder at same firing temperature and measurements related to magnetization, for the powder samples were made at room temperature. This confirmed the film results. The mechanical parameters of the films were calculated using nanoindentation technique and found to be substrate dependent and sol temperature dependent.