Cost Effective Low Temperature Fabrication of Barium Plumbate-Based Barrier Layer Capacitor Elements

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Introduction

The development of the electronic industry results in an increasing research potential oriented towards dielectric material in material sciences laboratories [1]. Ceramics capacitors have become the dominant due to its small size, reliability and can be manufactured cost effectively by highly mechanized process [2]. As computer and communication technologies improve, electronic information is moving increasingly large. Therefore, there is a growing demand for equipment to store information accurately and quickly. To meet these demands, electronic devices must use higher frequencies than ever before, as single-layer ceramic capacitor, microchip capacitors that can have very high frequencies in the latest information and communication equipment. Conventional disc-type monolithic ceramic capacitor usually resonates at lower frequencies due to the complexion of their lead wires and shape.

Research works aim to elaborate novel material of enhanced the properties. The well-known barium and strontium titanate-based materials are widely used as multiplayer capacitors (MLS) and barrier layer capacitors (BLC) because of their high permittivity. Barium-plumbate, stannate and titanate based materials were chosen as a novel materials on BLC studies. The materials were perovskite structured.

Materials and Methods

The materials were prepared using a standard solid-state reaction technique. The following compounds have been successfully prepared and investigated namely; $Ba_{1-x}Mg_xPbO_3$ and $Ba_{1-x}Sr_xPbO_3$. The dielectric investigations were performed by applied silver loaded epoxy acted as electrodes on the circular faces of the samples. The impedance measurements were performed in the frequency range 5 Hz – 10 MHz at room temperature for $Ba_{1-x}Sr_xPbO_3$ system and from 25 °C to 125°C for $Ba_{1-x}Mg_xPbO_3$. Other dielectric compounds based on stagnate and titanate systems were also studied. Solid-state route and self-sustained technique were used to synthesize MgO- SnO_2 system.

Results and Discussion

Frequency dependence of dielectric constant and dielectric loss of $Ba_{1-x}Sr_xPbO_3$ with the real part of pemittivities have lower values of about 15, but stable in a wider range of frequency stretches from 100 kHz to 10 MHz. Permittivity of $Ba_{1-x}Sr_xPbO_3$ has a maximum value of 1400 at 1 kHz with high loss factor at x=0.8. However, relatively stable permittivity, with low loss factor were obtained at higher frequency. Temperature dependence of dielectric constant and dielectric loss of $Ba_{1-x}Mg_xPbO_3$ system and temperature dependence of imaginary part of permittivity were observed for all samples [3]. The plot of resistivity, at 10 kHz, versus measurement temperature shows a thermally affected resistivity behavior of the samples. Negative temperature coefficient of resistance were observed for pure $BaPbO_3$ and 100% mol Mg-doped samples, while a positive temperature coefficient of resistance were observed for samples with higher Mg contents. The capacitance data obtained on stagnate samples sintered at various (T-t) schedules acquired at different temperatures remains constant over a wide range of frequency. The capacitance showed temperature- independent in the range 27°C to 300°C. Mg_2SnO_4 has a very weak temperature dependence of capacitance (TCC) and dielectric constant (TCK) in the range 27-300^{0}C over several decades of frequency domain [4,5,6].

Conclusions

The electrical property revealed that Mg_2SnO_4 compounds can be employed as capacitor elements which are thermally stable over the range 27-300^0 C

Benefits from the study

Capacitors are important electrical energy storage devices, which are useful electronic component in high frequency circuit applications such as electronic communication, telephone exchanger and middle frequency circuit. Themistor can be used for temperature controller, voltage regulator (NTC), current regulator (PTC) control and alarm set. The scientific findings reported in this research have great relevance to the modern electronic technology

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None.

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