CHAPTER I
INTRODUCTION

Piezoelectric materials are interesting and generally used as transducers and actuators. And also become attractive to many sensors and devices because of their extremely wide dynamic range, excellent linearity over their dynamic range, wide frequency range, compact yet highly sensitive, no moving parts, great variety of models available for nearly any purpose and, integration of the output signal provides velocity and displacement. Piezoelectric materials can be divided into two main types: ceramics and polymer. Piezoelectric ceramic materials—for example, Barium Titanate ($BaTiO_3$), Lead Titanate (PT), Barium Strontium Titante (BST) and Lead Zirconate Titanate (PZT)—have been widely used in many applications because of their superior piezoelectric properties. On the other hand they also have decisive disadvantages. Most problematic is their high acoustical impedance. Piezoelectric polymer is alternating choice, which has been widely studied because of their interesting piezoelectric properties, flexible, light weight and acoustic properties.

Poly(vinylidene fluoride) (PVDF) exhibited a strong piezoelectric effect. A thin film of PVDF that had been poled under appropriated conditions showed a very large piezoelectric coefficient, a value which is about ten times larger than had been observed in any other polymers. PVDF is inherently polar. The spatially symmetrical disposition of the hydrogen and fluorine atoms along the polymer chain gives rise to unique polarity effects that influence the electromechanical response, solubility, dielectric properties, crystal morphology and yield an unusually high dielectric constant. The dielectric constant of PVDF is about 12, which is four times greater than that of most polymers, and makes PVDF attractive for integration into devices as the signal to noise ratio is less for higher dielectric materials. However, its piezoelectric and dielectric constant still be low when compare with piezoelectric ceramics.

To improve piezoelectric properties, many people tried to increase dielectric constant of PVDF. So there are many methods: firstly, making PVDF-copolymer such as Poly(VDF-co-TrFE) and Poly(VDF-co-TeFE). Secondly, a polymer/ceramic composite which adding ceramic into the polymer matrix. Later, electrically-charged polymer—a method which create space-charge in cellular PVDF. And the last is laminated or multilayer film. Due to the low dielectric constant of the piezoelectric polymer, single layer has small dielectric constant and thus high electric impedance. The laminated system by applying a multilayer design can increase the electric field—because the charges can be stored at the interfaces of the layers—the higher capacitance and lower the impedance. Many applications such as transducer and hydrophone made of piezoelectric laminated films which have provided properties over certain properties of individual film layer at the same thickness.

The propose of this thesis is to increase dielectric and piezoelectric properties of PVDF thin film by making multilayer thin film. Laminated or Multilayer film can be obtained from compression molding technique. The multilayer films were composed of the layer of pure PVDF film alternatively laminating of the layer of PVDF-BST composite film in different series. These fabricated films are expected to show interesting piezoelectric behaviors and higher dielectric constant. In this study, PVDF-BST composite was used as a one of layer in laminated film of series as follows: PVDF/PVDF-BST bilayer film, PVDF/PVDF-BST/PVDF trilayer film and PVDF-BST/PVDF/PVDF-BST trilayer film. Moreover, the dielectric properties of PVDF film affected by stretching ratio were investigated.