CHAPTER I
INTRODUCTION

More recently, additional piezo/ferroelectric polymer materials have been discovered and are currently being investigated, including cyanopolymers, polyuria, polythioureas, aromatic polyamides, odd-numbered polyamide, and biopolymers. Although none of these new materials has yet achieved the piezoelectric properties available in commercial P(VDFTrFE) copolymers (Lewis et al., 1997). Most experimental, studies the dielectric and piezoelectric responses in polyvinylidene fluoride (PVDF), and their copolymers. Although melt-quenched and cold-drawn odd-numbered polyamide are also ferroelectric and have large piezoelectric coefficients, they have been relatively less investigated in this regard. Since the first experimental study of high piezoelectric activity in poled polymer films was reported. Odd-numbered polyamide, such as polyamide 7 and polyamide 11,are of interest due to their polar crystal structure and thermal stability from the point of view of piezoelectricity. Ferroelectric (odd-numbered) polyamide are also of special interest due to their electrochemical properties which are comparable to those of polyvinylidene fluoride (PVDF), making them suitable for applications in sensors, transducers and actuators (Sampson et al., 2012).

Nowadays, polyamide or nylon has been widely used as one of the most important thermoplastics because of its good thermal stability, fire resistance and mechanical properties (Bak et al., 2010; Ding et al., 2009). Piezoelectric and ferroelectric properties of odd-numbered polyamide is temperature dependent and larger than that in PVDF at higher temperatures above their glass transition temperature, Tg. The piezoelectric constant increases rapidly with temperature maximum. Stable d_{31} value of 17 pC/N and 14 pC/N are reported for polyamide 7 and polyamide 11. Polyamide is known to be hygroscopic, due to the presence of H-bonds. If amorphous phase absorp water, it will effect to piezoelectric properties, but not the crystalline phase (Miri et al., 2009). Moreover, the thermal expansion coefficient, CTE of polyamide is about 110 ppm/k. This films of polyamide will be limited by this effect dur to shrinkage at high temperature.

To challenge this problem, the bacterial cellulose that has low CTE will be added. Bacterial cellulose is nano-size cellulose product of bacteria Acetobacter xylinum, that has very low CTE which is 0.1 ppm/K (Nogi et al., 2008). The unique properties of bacterial cellulose have inspired attempts to use in a number of commercial products. Commercial items utilizing BC include tires, headphone membranes, high performance speaker diaphragms, high-grade paper, make-up pads, diet-food and textiles (Nasrullah el al., 2013). Advantage of bacterial cellulose on the thermal expansion was reported as the bacterial cellulose can reduce the CTE from 245 ppm/k to 4 ppm/k for neat acrylic resin and also increase young modulus from 25 MPa to 2,5 GPa for acrylic nanocomposite at a fiber content of 5wt% (Nogi et al ., 2008). However, when add bacterial cellulose was added at high content, the optical property of nanocomposite film will decrease and become opaque.

The purpose of this work aims to fabricate the thin film nanocomposite derived by the polar odd-numbered polyamide and the bacterial cellulose fiber. The ultimate piezoelectric properties coupling with good thermal and mechanical properties are required. The optimized ratio between BC and polyamide was investigated including the measurement of all related properties.