CHAPTER I

INTRODUCTION

Tactile. or touch sensors can be versatile in engineering sectors including robotic arms. material discrimination. shape recognition. detection of hardness as well as electronic device. There are several types of sensors based on pressure-sensing mechanisms: resistive. capacitive. and piezoelectric sensing schemes. In resistive sensors. a resistance change induced from the resistive material squeezed between electrodes is measured. A capacitive-sensing mechanism measures the capacitance change induced by the change in the gap between the electrodes. However. most of these are not suitable for touch screen display because of the non-transparency of the materials they are made of and they was traditionally fabricated on glass due to the excellence on roughness and transparency. but the flexibility limits its use. So there are many efforts to provide alternative polymers to replace the traditional one. The piezoelectric sensor is an ability to convert mechanical energy into electrical energy and vice versa, its means that when force was applied to the material then it subsequently responded on electrical signal.

Films of some polymers. such as polyvinylidene fluoride (PVDF) and its copolymers. opportunely conditioned. exhibit piezoelectric and pyroelectric properties with excellent sensitivity and a satisfactory dynamic response that have been exploited in the development of electronic devices. Moreover. they can be reduced to tiny compliant strips for embedding in a continuous elastic layer. Used as isolated sensors. actuators, or assembled into more complex multimodal devices, they offer challenging solutions in many application fields. For these reasons they can be regarded as interesting candidates for touch sensors or touch screen panel. The majority of the PVDF chains have a regular structure of alternating CH_2 and CF_2 groups. It has been widely reported that PVDF shows highly complicated crystalline structures and exhibits as least five possible types of crystal phase (α. β. δ. γ. and ε). The α and β-phases are commonly studied and also the most important polymorphs for PVDF and its copolymers. The crystalline phase of interest for PVDF electric properties is the polar β-phase because the alignment of molecular chains in the β-phase (all-trans planar zig-zag conformation) gives PVDF a much higher polarity compared with other PVDF phases due to the net dipole moment, accordingly providing the highest piezo and pyroelectric properties as well as electrical activity. This structure can be obtained either by using the PVDF trifluoroethylene copolymer [P(VDF-TrFE)] which has the tendency to crystallize directly in the polar β –phase, from melt under specific conditions such as high pressure, external electric field, ultra-fast cooling, and by mechanical stretching of the α –phase.

On the other hand, in order to use PVDF, especially in touch sensor applications, the intrinsic properties of the pure PVDF cannot fully meet these requirements. Therefore, an increased electrical properties of the polymer is necessary. Basically, preparing composites by introducing some nanofillers, such as carbon black, metal particles, carbon nanotubes, and nano-cellulose into the polymer matrix has been shown to be a good approach to make improvements. Moreover, there is a need to develop a touch sensor with high mechanical properties for their long term operation and tolerance to the applied force during electronic device lifetime.

Up to the present time, the cellulose composite is one of the most important transparent materials with flexible characteristic and also can improve dipole orientation of PVDF polymer chain. Cellulose is a interesting material because of its abundant availability, biodegradability, and low cost. The use of cellulose also generally provides numerous advantages including biodegradability, light weight, transparency, and high strength. Cellulose is typically separated from lignocellulosic plants, such as wood and agricultural crops, using mechanical treatment. Usually, lignin is also removed from the plant cell wall prior to fibrillation using chemical treatment. Moreover, some of researchers have proposed the novel method of cellulose preparation from bacterial species which called bacterial cellulose. The uniformity of cellulose prepared from bacterial is easier to control by means of bacterial digestion mechanism.

In fact, cellulose is a hydrophilic substance and able to forms irreversible aggregation when it dried, the most successful methods used to prepare the cellulose composites have been solution casting of dilute solution of matrix and cellulose. However, for larger scale production, these methods are slow and expensive. Consequently, extrusion compounding is one of the most promising methods for industrial processing because of the easy scale-up and the possibility in further molding of the materials. It also tends to reduce environmental hazards from the chemical substance. Our research interest focuses on extrusion processing of cellulose composites to be an alternative to current method efficiently.

The objective of this work is to develop the transparent and flexible touch sensor based on piezoelectric material for touch screen applications by blending co-polymer of PVDF, poly(vinylidene fluoride-co-Hexafluoropropylene) or PVDF-HFP, with cellulose. We compared two kinds of cellulose based material, extracted micro-crystalline cellulose (MCC) from sugarcane bagasses, and extracted bacterial cellulose (BC) from Nata de coco, as a filler to improve the dipole alignment of PVDF-HFP matrix by using melt mixing method followed by cast film process. The dielectric constant was measured as the electrical and piezoelectric properties. In addition, the morphological, thermal, and mechanical properties were analyzed and discussed based on basis properties for touch screen applications.