CHAPTER I
INTRODUCTION

Elastomer substrates can provide a large deformation over 100%. Size and shape of elastomer can be changed reversibly under external electric field applied; it is called an electroactive material. Polyurethane, acrylic, and silicon are widely used as the electroactive polymers. All of these materials have low stiffness, large-strain response, and reversibility that are the requirements of compliant electrode properties. Interestingly, natural rubber (NR) also possesses excellent mechanical properties as a common electroactive polymer which can crystallize impulsively when it is strained. Thailand is one of the NR productions of the world. The product is more than 3 million tons per year. The growing productions continue to increase from 3.05 million tons per year in 2007 up to 3.56 million tons in 2011, a 16.8 percentage increase (Manmoun, 2013). While in year 2012, the rubber production increased to 3.6 million tons, a 8.25 percentage increase (Sincharoenkul, 2012). So, adding value of Thai NR through the production of compliant electrodes can drive Thailand's economic.

Over the past decade, compliant electrode has been fabricated based on two-phase composites composed of conductive filler particles within an insulating polymer matrix (Kujawski *et al.*, 2010). For examples, polydimethylsiloxane filled with graphite (Dubois*etal.*, 2009; Kujawski*et al.*, 2010), and silicon rubber or silicone gel filled with carbon nanotube (Chua*et al.*, 2011; Jung*etal.*, 2010; Kim*et al.*, 2012). Carbon based nanofillers, are of particular interest in this field, have several forms such as synthetic graphite, carbon black, cokes, and etc. It can be used as the filler in various applications: electrical contacts, aircraft, tire and elastomer reinforcement, spacecraft composites, and etc. Graphene is one of carbon base materials; the graphene sheet is parallel two dimensional (2D), a single carbon layer in the crystalline honeycomb graphite lattice, with sp^2 hybridized carbon atoms strongly bonded in hexagonal rings. It is a great notice as a filler for polymer composites due to their unique properties such as high electrical

and thermal conductivity, optical, ultrahigh mechanical strength, at nano-sized value of particle (Sengupta *et al.*, 2011)

In this work, the compliant electrodes from NR as a matrix filled with graphene as a conductive filler are intensively fabricated and examined in term of graphene concentrations. The evaluations of the compliant electrode performance of the fabricated graphene/NR composites are carried out by using the melt rheometer in the tension mode. The electrical properties and mechanical properties of the composites are mainly investigated and compared with the commercial compliant electrode from Danfoss PolyPower®.