CHAPTER I
INTRODUCTION

Since the discovery of conductive polymers three decades ago, (Shirakawa *et al.*, 1977), conducting polymers have become the focus of major research and development activities around the globe (Heeger *et al.*, 2001; MacDiarmid *et al.*, 2001; Shirakawa *et al.*, 2001). Because their potential applications as highly conducting materials or "synthetic metals" (Nalva *et al.*, 1996; Skotheim *et al.* 1998; Chandrasekhar, 1999) include use in applications that range from electromagnetic shielding to antistatic coatings to corrosion protection to artificial muscles (Qi *et al.*, 2004; Bar Cohen *et al.*, 2004), sensors (McQuade *et al.*, 2001), and electronic devices (Kraft *et al.*, 1998; Mitschke *et al.*, 2000; Weder *et al.*, 2001).

Polyaniline (PANI) has emerged as one of the most promising conducting polymers that have been extensively studied. Because of its unique electrical conductivity, good environmental stability, high synthesized yield, and relatively low cost of monomer (Laska *et al.*, 1997; Kang *et al.*, 1998). Recently, PANI has been attempted to developing in conductive fibers. The self-standing PANI fibers show high electrical conductivity (1-650 S/cm) (Mattes *et al.*, 1997; Pomfret *et al.*, 2001; Bowman *et a*l., 2005), but their mechanical properties are stiff and brittle; tenacity is in the range of 2-19 cN/tex and elongation at break is in the range of 1-60% (Mattes *et al.*, 1997; Yang *et al.*, 2001; Bowman *et al.*, 2005). These properties limit to the application that required large strain and elastic deformation.

Elastomers are materials that can fulfill the deficient property of conductive polymers. The reversible deformation of elastomers is an important property that is necessary for the applications of conductive polymers. Therefore, electrically conductive polymer composites or blends become the most used way to improve the mechanical properties of conductive polymers. Several attempts have been extensively studied on electrically conductive composites or blends in terms of combining the elastometic properties of a rubbery host polymer with the conductive polymer. Such composite or blend materials were recently produced in the form of films and sheets, with several kinds of host polymers, such as ethylene-propylene-diene monomer (EPDM) rubber (Schmidt *et al.*, 2004; Faez *et al.*, 2002), silicone rubber (Yuping *et al.*, 2005), nitrile rubber (Yong *et al.*, 2006), polyisoprene (Xue H. *et al.*, 2001), polyurethane (Chwang *et al.*, 2004), acrylonitrile-butadiene-styrene (ABS) (Koul *et al.*, 2000), and PANI. The use of PANI instead of metallic fillers or carbon black offers a variety of advantages, including potentially decreased percolation threshold, reduced sloughing (carbon black) and cost (metallic fillers) (Virtanen *et al.*, 1997).

Natural rubber (NR) is one of the technologically most important elastomers and is widely used because of its unique combination of excellent elasticity, low swelling in water, large extension, good resilience, high abrasion resistance and low cost (Dick *et al.*, 2001). They also provide reversible deformation which is an important property that is necessary for the functions of several devices that range from deformation sensors to actuators.

Recently, Camillo *et al.* have reported that the blend film of NR and PANI has presented desirable combination between electrical conductivity and elastomeric property (Camillo *et al.*, 2005). To order to broaden application area of electrically conductive composite, in this work we have attractive to prepare composites in the form of fibers that are generally different in technical process, their properties (Wang *et al.*, 2000, Jianming *et al.*, 2005).

In the present work, we here report on the fabrication and investigation of electrically conducting elastomer fibers based on natural rubber (NR) and up to 10% w/w PANI can readily be fabricated by a wet spinning process. The composite fibers synergistically combine the elastic properties of the NR host with the conductive nature of the PANI filler. The mechanical and electrical properties were investigated in terms of composite composition and doping condition. We also explored the influence of unixial strain on the electrical conductivity and demonstrated the bending behavior of composite fiber under electric field.