CHAPTER I
INTRODUCTION

Development of smart materials is a challenging task due to the increasing demand for materials capable of carrying out various complex tasks. Field-responsive material is one type of the smart materials and can be responsive in a measurable way through its interaction with some external stimuli. The detectable characteristics can be either physical, mechanical, optical, electrical or magnetic properties while the external stimuli can be any form of energy or matter (Khan *et al.*, 1999). As seen in Fig. 1.1, the smart or active materials can exchange a kind of input stimulus into a kind of output response. Consequently, the materials can be classified as actuator and sensor according to the type of input driving force. Piezoelectric materials, shape-memory alloys, electrostrictive materials, magnetostrictive materials, and electrorheological liquids are some examples of currently available smart materials (www.intellimat.com).

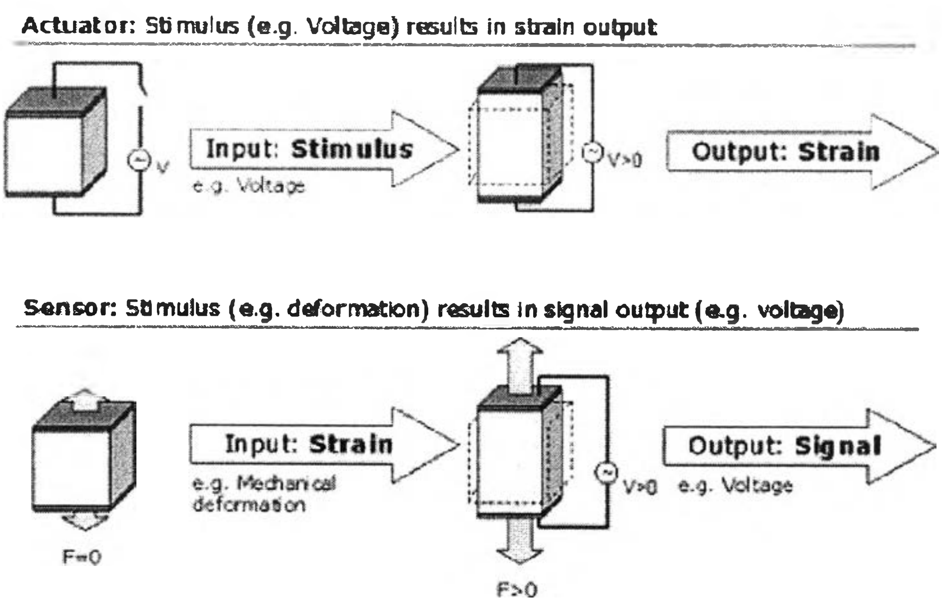

Figure 1.1 Approach for classification of smart or active materials.

Conjugated conductive polymers have been extensively studied as they provide a unique class of material. Poly(p-phenylene vinylene), PPV, is one of conductive polymers that has been explored because of its non linear optical properties, electroluminescence and high electrical conductivity upon doping (Damlin *et al.*, 2001). Applications of PPV include non-linear semiconductor, light-emitting electrochemical cells, battery, and sensor. Compared with other conductive polymers, poly(arylene vinylenes) (PAV) has a shorter conjugation length than that of PPV (Onishi *et al.*, 1991). However, PPV has some drawbacks: instability in air and low processibility (Mikael, 2000).

Recently, several attempts to modify PPV properties have been carried out especially on the processability of PPV (Yang *et al*, 2001). One possible approach to improve these properties is to prepare a tailored blend of a conducting polymer embedded in a flexible elastomer. There has been much recent interest in using elastomers as actuator material (Kornbluh *et al.*, 2002): thermoplastic elastomers (Spontak *et al.*, 2000), silicone elastomers (Wissler *et al.*, 2005 and Feher *et al.*, 2001), and polyurethane (Varga *et al.*, 2005 and Jung *et al.*, 2007). Elastomers have many advantages: they are lightweight; they have a high degree of mechanical response, and a fast response time.

In addition, conducting polymer also possess special and important characteristics making them suitable candidates for the controlled drug release applications because conductive polymer can change its oxidation state under applied electric field (Small *et al.,* 1995). However, a conductive polymer has certain limitations: only charged drugs can be released by the electrochemical control; large drugs, even though charged, cannot be easily released by the conducting polymer network; the ionic exchange that takes place between drug and the electrolyte media, independent of the oxidation state of the polymer, diminishes the capacity of the electrochemical control. In typical drug delivery systems, hydrogels have played a more accepted role than the conducting polymers; but they often have slow responses which limits the ability to deliver the stimuli efficiently throughout the gel (Lira *et al.,* 2005). Hydrogel is a three-dimensional network of hydrophilic polymers in which a large amount of water is present. The most characteristic property of hydrogel is that it swells in the presence of water and shrinks in the absence of water.

During swelling and shrinking processes, hydrogel can preserve its overall shape. Some hydrogels are capable of responding to external stimuli, such as pH, temperature, ionic strength and electric field (Murdan *et al.*, 2003). There are many monomers used for making various hydrogels e.g. acrylamide, methacrylate, acrylic acid and etc. In particular, acrylamide can be prepared in gel form and it is an electro-responsive hydrogel. Thus blends consisting of a conductive polymer and a hydrogel have attracted attention because they can fulfill two important requisites of the ideal drug release device: the possibility of switch on/off and the precise control the release rate as functions of the applied potential.

In the present contribution, we are interested in development of a conductive polymer based elastomer and hydrogel of poly(p-phenylene vinylene)/polydimethylsiloxane and (p-phenylene vinylene)/polypolyacrylamide blends as candidate materials for actuator and transdermal drug delivery.