สำนักงานวิทยทรัพยากร จุฬาลงกรณ์มหาวิทยาลัย

CHAPTER I
INTRODUCTION

The exchange of electrical energy for mechanical energy has been of scientific and technological interests for many decades. Electromechanical energy conversion has been applied in many applications such as muscle/insect-like actuators, robotic, and etc. [Wichiansee *et al.*, 2009]. The development of electroactive materials for artificial muscle or actuator is very attractive because it has many advantages. First, the electroactive materials resemble natural living tissues more than any other classes of synthetic biomaterials because to their high water contents, soft consistency, and their activation mode. Secondly it is biocompatible and not biodegradable. Third, their physical and chemical properties vary with composition and can be tailored as desired. Fourth, they can take various shapes and they are a low-cost material.

Gelatin is a protein biopolymer derived from the partial hydrolysis of native collagens, which are the most abundant structural proteins found in the animal body of skin, tendon, cartilage, and bone [Zhang *et al.*, 2006]. Due to a wealth of merits such as biological origin, non-immunogenicity, biodegradability, biocompatibility, and commercial availability at relatively low cost, gelatin has been widely used in the pharmaceutical and medical fields as sealants for vascular prostheses, carrier for drug delivery, wound dressings, and artificial muscle [Marois *et al.*, 1995]. On the other hand, gelatin exhibits poor mechanical properties which limit its possible applications as a biomaterial. The improvement of the mechanical properties of drawn gelatin has been related to the renaturation level of the protein, evaluated through differential scanning calorimetry [Bigi *et al.*, 2001]. In the literature, several physical and chemical methods have been reported for crosslinking collagenous materials. Physical methods include the dehydrothermal treatment and the UV irradiation [Bottom *et al.*, 1966; Fujimora *et al.*, 1965] however, they are generally less efficient. Many chemicals such as formaldehyde, glutaraldehyde, carbodiimide and dextran dialdehyde, have been used to chemically modify gelatin for biomedical applications. Amongst them, glutaraldehyde (GTA) is by far the most widely used chemical, due to its high efficiency in stabilizing collagenous materials [Damink et

al., 1995]. GTA based crosslinking of collagenous materials significantly reduces biodegradation, making the materials biocompatible and nonthrombogenic while preserving biological integrity, strength and flexibility. GTA is also easily available, inexpensive and capable of accomplishing the crosslinking in a relatively short time period.

In our work, we are interested in gelatin as a candidate for artificial muscle or actuator. The electromechanical properties, thermal properties , are measured as functions of gelatin strength, crosslinking ratio, temperature, frequency, and electric field strength.