CHAPTER I

INTRODUCTION

Nanoscaled architectures of nanoparticle deposited on substrates have attracted tremendous interest because of their potential applications in nanoelectronic devices, catalyst, sensor, and nonlinear optical devices. Gold nanoparticles have been deposited on surfaces for a number of purposes, including physical studies [1] and derivatization of self-assembled monolayer [2]. Privileged materials being substrate for deposition include silicon [3-5], titanium (IV) oxide [6-7], alumina [8], ammonium salts [9], and various forms of carbon such as fullerene [10], nanotubes [11], and diamond [12].

The chemical inertness and resistance to surface oxidation make gold an important material for the use in nano-scale technologies and devices. This property is crucial when particle size approaches the nano-scale and the dominance of surface atoms results in an enhanced chemical reactivity [13]. Though the resistance to surface oxidation is maintained in nanoparticles of gold, the chemical inertness of bulk gold is lost, and a heightened catalytic behavior is observed [14]. Other materials that share similar corrosion resistance as gold are silver and platinum. However, silver is considered too reactive and platinum is significantly more expensive than gold.

Gold nanoparticles deposited on the previously mentioned surfaces are limited to substrate with rigid body, which can not be used in flexible application [15]. For application requiring flexibility, the substrate must be flexible. Privileged materials for deposition are polymer, such as polystyrene [16] and Nylon-1,1 [17-19].

Polyimide is a high-temperature engineering polymer. Its properties are more dominating than other polymers. Comparing to other organic or polymeric materials, polyimide exhibits an exceptional combination of thermal stability, mechanical toughness and chemical resistance. Polyimide also has excellent dielectric properties. Because of high degree of ductility, polyimide can be readily implemented into variety of electronic applications. Therefore, polyimide is chosen to be the substrate for gold nanoparticles deposition in this work because the fabricated gold nanoparticle thin film on polyimide substrates can increase the potential of applications, such as nanoelectronic devices and sensor.

Techniques for deposition of gold nanoparticles on substrate have been previously discovered, such as infiltration of nanoparticles [20], layer-by-layer self-assembly (LBL) technology [21], electrochemical deposition [22], surface vertical deposition [23] and electroless deposition technique [24]. Among these techniques electroless deposition is used frequently for particle assembly on substrate. This technique is cost effective comparing to the methods, such as chemical vapor deposition (CVD) and sputtering. The electroless deposition technique has many advantages such that metal can be deposited on non-conducting materials, such as glass and polymers. The process is also simple to operate and the deposition can be done onto substrate in any shape, including the inside of hollow plastic tubes.

This research focuses on gold nanoparticles deposition on both modified glass and polyimide substrate by electroless deposition on technique. The study emphasizes on substrates surface modification by assistance of surface modifying agent. i.e. 3-aminopropyltrimethoxysilane (APTMS), polyethylenimine (PEI) [5] and (3-mercaptopropyl) trimethoxysilane (MPTMS) [25]. Various deposition conditions including functional concentration, surface modification time and AuNPs deposition times were also investigated.

The objectives of this research are as follows:

1. To fabricate gold nanoparticle thin film on polyimide substrate and compare to gold nanoparticle thin film deposited on glass slide.

2. To investigate the effects of various factors, such as used surface modifying agents, deposition time and anneal temperature on the properties of gold nanoparticle thin film deposited on glass slide and polyimide substrate.

This thesis is arranged as follows:

Chapter I is the introduction of this work

Chapter II consists of the theory and survey of literature, relating to this research.

Chapter III describes the experimental procedures used in this study

Chapter IV presents experimental results and discussion.

Chapter V presents overall conclusions of this research and recommendations for future research.