CHAPTER I

INTRODUCTION

During the past three decades since the commercialization of Kapton polyimide, many impressive varieties of polyimides have been synthesized because of both scientific and commercial interests [1]. Polyimides posses outstanding key properties such as thermoxidative stability, high mechanical strength, high modulus, superior chemical resistance, excellent electrical properties, low dielectric constant, low relative permittivity, inertness to solvents, good adhesion properties, and high thermal stability.

The first commercial polyimide film was introduced by DuPont, thus up to present, polyimides have increased in commercial importance. Thermoplastic polyimides that can be melted processed have been developed for some injection molding and composite applications [2]. The most notable use of polyimides is in the electronics industry, primarily in applications as films or coating. The use of polyimides in microelectronics applications dates back to the early 1970s. In the electronics industry, polyimide coatings are used in a variety of interconnect and packaging applications, including passivation layers and stress buffers on integrated circuits and interlayer dielectrics in high-density interconnects on multichip modules [14].

The development of polyimides for electronics applications has focused primarily on the role of chemical structure in providing the desired properties, but little attention has been paid to the importance of the conditions used to make the coatings or films. Coatings are prepared when polyimide precursor solutions are applied to a substrate and subsequently cured on the substrate. These coatings are frequently used as interlayer dielectrics and stress buffers. Free-standing films are generally prepared by casting the precursor on a surface and then removing the film from the surface after drying, partial imidization, or complete cure.

Recently, dendritic macromolecules have attracted considerable attention due to new physical and chemical properties caused by their unique structures. They are mainly classified into dendrimers with well-defined structures and hyperbranched polymers having statistically branched architecture. Although the synthesis of dendrimers requires many reaction steps, hyperbranched polymers are prepared by one-step polymerization monomers and seem to be suitable for large scale production. As compared to their linear analogues, hyperbranched polymers possess good solubility in organic solvents, decreased viscosity and interchain entanglement. In addition, various functional groups can be introduced into their structures to create new functional polymeric materials.

Of the many nanomaterials available today, polyhedral oligomeric silsesquioxanes (POSS) are low dielectric constant materials which can also made by incorporating into the polyimide matrix. POSS has a unique and well defined structure that can be used for preparing hybrid materials with well defined structure and resultant materials possesses improved thermal and mechanical properties.

In this research, the synthesis polyimides and incorporation of POSS to the side chain of polyimide will be examined. By incorporating hyperbranched polyether, the second and third layers can be performed. The addition of the hyperbranched polyether is expected to be a higher solubility in organic solvents and decrease for the dielectric constant of hyperbranch polyimide. The solubility, thermal and mechanical properties as well as electrical and dielectric properties will be investigated.

1.1 The Objectives of This Thesis

To synthesize hyperbranch polyether on polyimide and to investigate the effects of varied layers polyether on the properties of the synthesized polyimide.

1.2 The Scope of This Thesis

1.2.1 Synthesize polyimide from 4,4′-(Hexafluoroisopropylidene) diphthalic anhydride (6 FDA), 3,4′-oxydianiline (ODA), 3,3′-Dihydroxy-4,4′-diamino biphenyl (DHBP), and Phthalic anhydride (PA).

1.2.2 Grow hyperbranch polyether on polyimide about 1-3 layers.

1.2.3 Prepare polyimide film.

1.2.4 Characterize properties of polyimide obtained with fourier transform infrared spectroscopy (FT-IR), thermal gravimetric analysis (TGA), dynamic mechanical analysis (DMA), LCR meter, and tensile testing machine.

This thesis is divided into six chapters as follows:

Chapter I provide an overview of the polyimide and objective and scope of this thesis.

Chapter II explains the basic theory about this work such as polyimide definition, type of polyimide polymerization, polyhedral oligomeric silsesquioxanes (POSS), polyether characteristic and branched system.

Chapter III presents literature reviews of the previous works related to this research.

Chapter IV shows the experimental equipments and experimental procedures to synthesis polyimide and polyether and preparation of hyperbranch polyimide film. Including, instruments and techniques used for characterizing the resulting polymers.

Chapter V exhibits the experimental results on polyimide-POSS composite, and effects of varied layers polyether on the properties of the synthesized polyimide.

Chapter VI, the last chapter, shows overall conclusions of this research and recommendations for future research.