สำนักงานวิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

CHAPTER I

INTRODUCTION

Alumina is one of the most common inorganic materials. It has been recognized for its high strength and modulus, resistance to attack by molten metals and non-oxide materials, chemical inertness in both oxidizing and reducing atmospheres up to 1000°C, low thermal conductivity and good electrical insulation [Chawla 1998]. Alumina ceramics have great potential for catalyst, catalyst support and ceramics membrane. Alumina fiber is an important engineering material used in various applications including high-temperature insulation, corrosive resistance materials, catalyst support in high-temperature reactions, fire protection and as reinforcement for resins, metals and ceramic [Bunsell 2005; Hamling 1997; Chambers et al. 1998].

Sol-gel technique is one of a few methods that can easily prepare various forms of alumina. Sol is colloidal suspension of solid particles in liquid. Transformation of sol to three-dimensional network of solid, called gel, via chemical reaction can result in novel materials with complex structure. The basis for prepared alumina via sol-gel process and its application were first described by Yoldas in 1975 [Yoldas 1975]. Initial preparation of alumina via sol-gel process has been used to produce a transparent alumina [Yoldas 1975].

Electrospinning is a unique fiber spinning process originally designed for the synthesis of polymer nanofibers. This technique employs electrical field to aid the thinning of the fiber. It can produce fibers with diameter of 50–500 nm [Doshi and Reneker 1995; Subbiah et al. 2005; Huang et al. 2003]. The morphology of the fiber depends on the process parameters, including solution concentration, applied electrical field strength, deposition distance and deposition time, which have been analyzed in the previous studies [Fong et al. 1999; Dietzel et al. 2001].

In recent years, alumina nanofibers, which are produced by combined sol-gel and electrospinning technique, have become an interesting material. Many alumina

sources and polymers, which are used as the spinning aid, have been employed in the study of the preparation of alumina nanofibers via the electrospinning. The results conclusively show that alumina nanofibers could be produced by the combination of such techniques [Azad 2006; Panda and Ramakrishna 2007].

Nevertheless, it has been recognized that condition for the preparation of spinning solution is one of the important factors affecting final properties of alumina products. The parameters such as types of solvent, water to alumina ratio, pH, rate of calcination and additives, can influence morphology, particle size, and crystallite structure of the fibers [Teoh et al. 2007; Venkatesh and Ramanan 2000; Gonzalez et al. 1997; Sharma et al. 2003; Pathak et al. 2002; Alves et al. 2005].

Although combining sol-gel and electrospinning techniques have already been widely used in many works, fundamental knowledge is not clearly understood. Many of investigations on ceramic nanofibers synthesis focus only on parameters electrospinning technique and ignore parameters about sol and gel formation. In this study, detailed investigation focusing on the electrospinning solution is presented. Alumina nanofibers were prepared by using aluminum isopropoxide as alumina precursor and polyvinyl alcohol as the spinning aid. Morphology, phase transformation and the effect of acidity in the spinning solution were investigated in this research.