CHAPTER I

INTRODUCTION

1.1 Background

Alumina or aluminium(III) oxide (Al_2O_3) is an advance ceramic material with various outstanding properties. Transparency is one of the most promising properties for varieties of applications. For instance, transparent alumina is used for accomodating the electrical plasma generated in high-pressure sodium street lamps. Moreover, they have been developed for nose cones of heat-seeking missiles on window for fighter aircraft. It is also known that characteristics of transparent alumina are high compressive strength, excellent corrosive resistance and high refractoriness.

Normally, transparent property of alumina ceramic could be obtained from single crystal alumina (SCA). But the high cost of manufacturing often precludes their common use. Polycrystalline alumina (PCA) would be an alternative to produce transparency. Coble invented the translucent alumina tube made from high-density polycrystalline alumina manufactured by a process that promotes controlled grain growth. Apetz and Bruggen (2003) proposed the sintered PCA consisting of mean grain sizes smaller than 2 μm could provide outstanding optical transmitting property refer to the Rayleigh scattering model. However, sintering of ceramic specimens at high temperature to increase their density could oppositely result in growing of crystal grain. Therefore, a controlled sintering process at comparatively low temperature to avoid grain growth is a key to get transparent alumina sintered specimens.

In general there are various shaping methods to prepare ceramic specimens. Slip casting is normally used for forming traditional ceramics because it can fabricate green body specimen in complicated shape with relatively high density. An important issue to fabricate green body with high density is to control slurry viscosity while solid content with uniform dispersion must be controlled which proposed by Omura et al. (2006). The high density of green body prepared by slip casting method successfully leads to the fully density of the sintered body that is possibly to invent

the transparency. Nevertheless, disadvantage of the method is contamination of some particular ion, such as calcium and sulfate from gypsum mold which in turn affect transparency of sintered product. Hotta, Banno and Oda (2002) proposed the method to eliminate that contamination using chemicals treatment such an acid before taking into the sintering. It was reported that acid treatment can help improve its microstructure and grain growth behavior during the sintering process. Moreover the treatment prosperously produced the translucent alumina ceramics with pellet shape prepared by slip casting using a gypsum mold.

The purpose of this work is to investigate the possibility to fabricate transparent alumina ceramic specimens with complicated shape prepared by slip casting method.

1.2 Objectives of research

The objectives of this research are to prepare alumina green body with complicated shape by slip casting method which investigated on the addition of binder into alumina slurry. And then it is to conduct the effect of sintering process and their transparency will also be examined to find optimal condition to get transparent alumina specimens with complicated shape.

1.3 Scopes of research

1.3.1 Prepare the alumina suspension by investigated optimum concentration of binder.

1.3.2 Design slip casting process which could provide green body with complicated shape.

1.3.3 Analyze pre-sintering condition with varying following parameters:

a) Type of furnace

b) Sintering temperature

c) Soaking time

d) Two step sintering

1.3.4 Study sintered HIPing conditions, in particular temperature, on the transparency of alumina specimens.

1.3.5 Characterize the obtained products in each steps of process. Following analysis will be performed.

a) Characterize the alumina slurries by measuring their viscosity.

b) Characterize the green bodies by measuring the strength.

c) Characterize the calcined bodies by measuring the density.

d) Characterize the sintered bodies by measuring the density, the microstructure, the grain size, the shrinkage and the transmission of light.

1.4 Benefit of research

The expected benefit from this research is the knowledge to fabricate transparent alumina with complicated shape of polycrystalline replaced single crystal and understanding about the molding shape by slip casting method.