CHAPTER I

INTRODUCTION

1.1 Background

Alumina (Al_2O_3), especially transparent single-crystal alumina (SCA) is one of the most promising advanced materials used for many substantial applications. Due to its superior characteristics, i.e., high compressive strength, excellent wear and corrosive resistance and high refractoriness, It is used as envelop of high-pressure sodium lamp, windows for furnace and armor tank, protection area for thermocouple and numerous parts in the high reliable equipments.

However, Manufacturing of SCA requires substantial investment of high - temperature resistant equipments and enormous operating energy for melting the alumina powder. For these reasons, extensive researchers have been tried to develop the alternative to produce transparent alumina using the ceramic process to give the poly-crystal alumina (PCA) with transparent properties instead of.

Nevertheless, optical property of conventional PCA is not transparent or translucent because of effects of its micrometer size grains and porosity. Recently, it has been reported that transparent PCA ceramic with the grains size in nanometer to submicrometer order could be made. Transparent alumina can be obtained using ultrafine alumina powder combined with appropriate fabrication to give sintered product with minimized porosity and grain growth in submicron order. To get that kind of product, the alumina green body must exhibit high density. From the surveys, slip casting is one of the traditional fabrication processes have been employed to give this condition as well as high homogeneity, complexity in figures and low operating cost. However, this technique provides the contamination of some particular ion, such as Calcium and Sulfur from gypsum mold, which were affected to transparency of sintered product. Besides using carefully prepared gypsum mold, this contamination problem can be avoided by using the resin mold which requires much more expensive operating cost instead of.

So far, there have not been any technical reports which reveal that using of conventional gypsum mold to prepare Alumina green body could give rise to product with very high density but low contamination. Hence, some of researcher 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 to improve its microstructure and grain growth behavior during the sintering process. In order to prepare alumina green body with high density and strength for producing alumina optical ceramic, a combination of additives such as deflocculants and binders concentration, acid treatment process and sintering condition will experimentally be investigated using carefully prepared with gypsum mold.

1.2 Objective of the Research

The main objective of this research is to conduct experiments to produce the alumina green body with high density from ultrafine alumina powder for preparation of optical alumina ceramic and then investigate the effect of deflocculant binder concentration on the properties of alumina suspension, green body alumina and effect of acid treatment and sintering condition on alumina sintered body.

1.3 Scope of the Research

1. Prepare the alumina suspension

1.1 Prepare the well-dispersed alumina suspension with 70%, 75% and 80% solid loading by varying the concentration of deflcooculant.

1.2 Prepare the well-dispersed 70% and 75% solid loading of alumina suspensions with binder.

2. Carry out experiments on preparation of green body by slip casting in gypsum mold with alumina suspensions.

3. Carry out experiment on preparation of sintered body with acid treatment and without acid treatment from calcined body.

4. Characterize the obtained products in each steps of process, as follows;

4.1 Characterize the alumina slurries by measuring its viscosity.

4.2 Characterize the obtained alumina green body by measuring strength and density.

4.3 Characterize the obtained sintered products by measuring density (using Archimedes method) morphology observation (using SEM), shrinkage and transmission of light (using UV-visible spectrophotometer).

1.4 Expected Benefits

1. Gain knowledge of ceramics forming with slip casting technique.

2. Understand the effect of deflocculant and binder concentration on the properties of alumina suspension, green body and sintered body of alumina ceramic.

3. Gain knowledge of acid treatment effect after calcining on the properties of sintered body.

4. Gain knowledge of slip casting technique should be adaptable for producing transparent alumina ceramic.