CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The main purpose of this research is to explore possibility to employ a slip casting method to fabricate polycrystalline alumina specimens with complicated shape which could exhibit optical transparency. There are two main parts in this work. The first part involved the investigation of the optimal addition of PVA binder into alumina slurry, which could allow preparing green body by slip casting. The second part was the investigation of sintering process of alumina sample to obtain the full density and submicron grain size which could lead to improvement of the transparency of polycrystalline alumina. From the experimental results, it can be concluded as follows:

5.1.1 The addition of PVA binder

With the slip casting method, the well dispersed alumina slurry added with optimal amount of PVA binder could provide green body with sufficient strength. Such slurry could be molded and retained in the desired shape without breakage. Based on experimental results, the optimal amount of PVA binder for slip casting would not exceed 0.2 wt% with 75 wt% alumina content. Slurry with this composition was successfully molded to form the pellet and alphabet shapes by slip casting. Inversely, the excessive binder resulted in the highly viscous slurry which was not applicable for preparing green body. As a result, the alumina calcined specimen prepared by slip casting with the optimal binder could exhibit the relative density up to 58%.

5.1.2 The investigation of sintering process

Types of furnace, sintering temperature and soaking time in pre-sintering step were important factors to get the full dense alumina specimen. The pre-sintering with 1300°C at atmospheric at high temperature was suitable for preparing full density samples. Meanwhile, the pre-sintering with excessively long soaking time could result in undesirable grain growth. Furthermore, the two-step sintering as an alternative pre sintering was employed to obtain the full density and control grain growth mechanism. The specimens after pre-sintering exhibited full density but still had insufficient transparency. This is attributed to the residual pores forming in the inner grain. Therefore, the alumina specimens would be treated by the post-sintering will a HIP furnace to eliminate the residual pores. Inversely, the grain size increased after HIP sintering. However, the HIP specimens could exhibit pretty good transparency owing to the controlled grain size at the submicron level. Both of circular pellet and alphabet-shaped specimens have a high transparency after being HIPed.

5.2 Recommendations for future work

1. The addition of PVA binder usually occur the bubbles in the well dispersed alumina slurry. Besides, the bubble arises during the ball milling process to mix the slurry. Thus, the effectiveness removal bubble method should be concerned.

2. The vacuum furnace with metal heating element will be study to get full density in pre-sintering part.

3. The new sintering technique to gain the full density and the suppression grain growth mechanism will be investigated for example, the two-step sintering method.

4. The HIPing conditions will be examined such as lower pressure or shorter soaking time to develop better transparent alumina.