CHAPTER 1

INTRODUCTION

1.1 Introduction

Si_3N_4 was difficult to sinter without oxide additives since it had strong covalent bond.[1-2] Hence, available sintering additives such as MgO, Y_2O_3, Y_2O_3-Al_2O_3 must be used to enhance densification.[3-5] Especially, Y_2O_3 had shown good densification and high strengthening in SiO_2-Y_2O_3 composition.[6-8] Furthermore, enhancing sinterability and fracture toughness was found in α- Si_3N_4 compact with Y_2O_3-Al_2O_3 sintering additive system.[9]

Many techniques for the sintering of Si_3N_4, which were classified by pressure such as hot pressing, gas pressure sintering and pressureless sintering, had been reported. Hot pressing Si_3N_4 exhibited excellent mechanical strength at high temperature.[10-11] Although hot pressing technique was easy to enhance densification of Si_3N_4 ceramics, this process was not economically suited to the production of complex shapes. Consequently, its application was prohibited.[12-13] Thus, sintered Si_3N_4 in N_2 gas atmosphere with certain sintering additives were reported.[14-16] By the sintering method, complex shapes with density and strength similar to hot pressing can be consolidated. However, it is still uneconomical because of the high costs incurred by the nature of the processing technique, which needs special furnace. Pressureless sintering is more favored processing method for many ceramics, but until recently it is an expensive method because N_2 gas furnace is needed to obtain the full density.[18-21]

Recently, Si_3N_4 ceramic was successfully sintered without serious mass loss in air as well as in N_2 gas furnace.[22] However, the process conditions were not fully described. Much work still remains to be done. For example, agglomeration of Si_3N_4 and Al_2O_3 packing powder, mass loss with increasing of sintering temperature, phase analysis and mechanical property of sintered ceramics have not been reported.

The purpose of this experiment is to clarify about above mentioned parameters in air atmosphere furnace for Si_3N_4 ceramic consisting of two composition ratios of Y_2O_3- Al_2O_3 additives, which is sintered at temperature ranging from 1550 ^{O}C to 1700 ^{0}C. The α-β transformation measurement, and second phase analysis were also preformed.

1.2 Targets of this study

1. To find Si_3N_4 and Al_2O_3 packing powders which do not agglomerate.
2. To observe the deterioration of Al_2O_3 crucible.
3. To get the full density and homogeneous Si_3N_4 specimen.
   (Density should be greater than 95% of theoretical density)
4. To get more technological knowledge on the sintering of Si_3N_4 in air furnace such as phase transformation and mechanical property.