CHAPTER I

INTRODUCTION

Al_2O_3-TiC composite is an interesting material because of its advantages such as high hardness, good strength, excellent wear resistant, moderate fracture toughness and chemically inertness. It is widely used in industry as cutting tools for machining high hardness materials and in modern application as magnetic recording head substrates [1]. Moreover it can be used as hard and wear protective coating.

Generally, this ceramic composite is fabricated by directly mixing of Al_2O_3 and TiC powders , followed by pressureless sintering, hot pressing or hot-isostatic pressing [2,3]. The commercial composition is usually Al_2O_3 – 30%wt TiC. An alternative method to prepare this composite utilizes self-sustained exothermic reaction between reactants to prepare materials. It is called self-propagating high temperature synthesis (SHS) or combustion synthesis. The process begins with initial reagents, after ignition; there is sufficient heat release that leads to the formation of a combustion wave which travels along the reactants, converting them to the required product [4]. This method offers several advantages including its simplicity, energy efficiency and the use of low cost precursor.

Recently, microwave technology has drawn much attention of numerous researchers. Microwave processing of material is fundamentally different from conventional processing in its heating mechanism. In microwave heating, heat is generated within the sample itself by interaction of microwaves with the material [5]. In conventional heating, the heat generated by heating elements is transferred to the sample surface, and then transferred to the interior by conduction. Heat generated by microwave energy depends on microwave absorption efficiency of material. The main advantages of using microwave energy are energy reduction, shorter processing time and improved properties. In addition to microwave firing, heating rates from 100 - 150 ^{o}C/min can be used to fully sintered ceramics without cracking. Slow heating rate and long dwelling time during conventional sintering promote grain growth that is an inherent problem in the sintering and densification of nanoceramics. With short microwave sintering runs, the time for grain growth is diminished. The resulting smaller grains make the microstructure more uniform and increase the strength as was shown to be the case for increasing the strength of wear parts ceramics like ZrO_2 and Al_2O_3 [6].

In recent years, the developments using microwave energy for high temperature process are discussed. The effectiveness of using microwaves to promote heating for drying, calcination, binder removal, glass melting have been demonstrated in laboratories through out the world, some processes have become an industrial reality [7]. However, high temperature processing is just beginning to find the way. The use of microwave energy as a heating source for combustion synthesis has been limited [8]. The effects of various types of precursors on microwave combustion behaviors are rare. Hence, the propose of this study is to utilize microwave energy to synthesize and sinter Al_2O_3-TiC composite.

The first objective is to synthesize the Al_2O_3-47wt%TiC composite powders via the combustion synthesis under microwave energy and conventional heating for comparison. The effect of various types of precursors on combustion behavior and powder characteristics of Al_2O_3-47wt%TiC powders was investigated. The second objective is to fabricate Al_2O_3-TiC composite by uniaxial-pressing the microwave combusted-powders. Their appropriated sintering conditions under microwave energy were investigated. The pressureless sintering of conventional-combusted Al_2O_3-47wt%TiC powder was also performed for comparison.