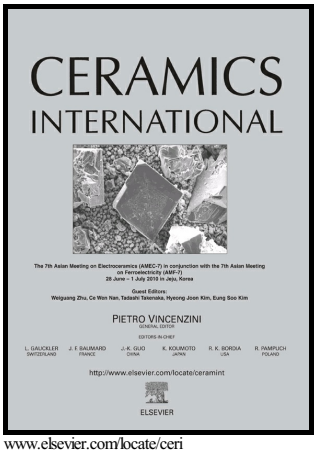
Spark Plasma Sintering of Silicon Nitride/Barium Aluminum Silicate Composite

S. Bahrami, M. Zakeri, A. Faeghinia, M.R. Rahimipour



www.elsevier.com/locate/ceri

PII: S0272-8842(17)30665-X
DOI: http://dx.doi.org/10.1016/j.ceramint.2017.04.065
Reference: CERI15045

To appear in: *Ceramics International*

Received date: 16 January 2017
Revised date: 10 April 2017
Accepted date: 10 April 2017

Cite this article as: S. Bahrami, M. Zakeri, A. Faeghinia and M.R. Rahimipour Spark Plasma Sintering of Silicon Nitride/Barium Aluminum Silicate Composite *Ceramics International,* http://dx.doi.org/10.1016/j.ceramint.2017.04.065

Spark Plasma Sintering of Silicon Nitride/Barium Aluminum Silicate Composite

S. Bahrami, M. Zakeri*, A. Faeghinia, M.R. Rahimipour
Ceramic department, Materials and Energy Research Center, Karaj, Iran
*Tel.:+98(26)36204131; fax: +98(26)36201888. m_zakeri@merc.ac.ir

Abstract
Si_3N_4 based composites were successfully sintered by spark plasma sintering using low cost $BaCO_3$, SiO_2 and Al_2O_3 as additives. Powder mixtures were sintered at 1600 to 1800ºC for 5 and 10 min. Displacement-temperature-time (DTT) diagrams were used to evaluate the sintering behavior. Shrinkage curve revealed that densification was performed between 1100-1700ºC. The specimen sintered at 1700ºC showed the maximum relative density (99.8±0.1%), flexural strength (352±16MPa), Vickers harness (11±0.1GPa) and toughness (5.6±0.05MPa.$m^{1/2}$).

Keywords: Silicon nitride, Spark plasma sintering.

1-Introduction

Advance ceramics have been developed for a number of commercial and industrial applications, including turbine engines, reciprocating heat engines, waste incineration, electronic packaging, armor, cutting tools and missile radomes [1]. Among the advanced ceramics, Si_3N_4 has shown excellent mechanical, physical and chemical properties. Therefore, it has been considered as a promising wave-transparent material to be used in high temperature environment and radomes with high supersonic and hypersonic speeds [2].

There are two well-known phase of silicon nitride, α and β both having hexagonal structure. α-Si_3N_4 is thermodynamically stable at low temperatures and it irreversibly transforms to β at high temperatures[3]. Richardson et al. reported that α to β transformation cannot be completed during pressure-less sintering at 1800ºC for 7h because of its slow reaction rate[4]. Therefore, researchers have proposed using spark plasma sintering to promote α to β transformation at short time. Spark plasma sintering (SPS) is a powerful technique for sintering of silicon nitride at lower temperature and