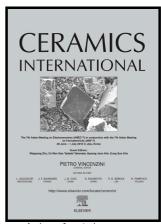
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Optimization of spark plasma sintering parameters of Si₃N₄-SiC composite using response surface

methodology (RSM)

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Abstract

The Si₃N₄-SiC micro-nano composites were fabricated via the spark plasma sintering method using

MgSiN₂ as an additive. Response surface methodology and central composite design were applied to

optimize the spark plasma sintering process for the fabrication of Si₃N₄-SiC/MgSiN₂ with improved

density. The relation between the three parameters of sintering including temperature, pressure, and

holding time was modeled and the optimized parameters were obtained. The best sintering results obtained

for the sintering temperature, holding time, and pressure are 1700°C, 487s, and 49 MPa, respectively. The

addition of MgSiN₂ as an additive and SiC as a secondary phase were also investigated in the present work.

The Si₃N₄-5 vol.% SiC composite exhibited high hardness (19 GPa) and fracture toughness values (6.5

 $MPa.m^{1/2}$) at room temperature.

Keywords: silicon nitride; composite; Response surface methodology; spark plasma sintering

1. Introduction

Reinforced ceramic matrix composites have found many high-temperature applications such as in turbines,

automobile engine components, heat exchangers, and refractory materials [1]. Si₃N₄-based composites are

among the interests in engineering applications such as gas turbines, engine core components, and cutting

tools because of their favorable mechanical properties at high temperature, resistance to oxidation and

1

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