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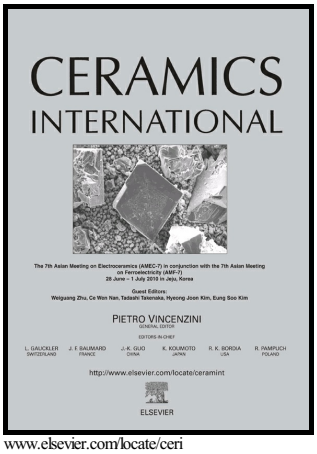

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Transient liquid phase diffusion process for porous mullite ceramics with excellent mechanical properties

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Abstract

Porous mullite ceramics were fabricated by the transient liquid phase diffusion process, using quartz and fly-ash floating bead (FABA) particles and corundum fines as starting materials. The effects of sintering temperatures on the evolution of phase composition and microstructure, linear shrinkage, porosity and compressive strength of ceramics were investigated. It is found that a large amount of quartz and FABA particles can be transformed into SiO_2-rich liquid phase during the sintering process, and the liquid phase is transient in the Al_2O_3-SiO_2 system, which can accelerate the mullitization rate and promote the growth of mullite grains. A large number of closed pores in the mullite ceramics are formed due to the transient liquid phase diffusion at elevated temperatures. The porous mullite ceramics with high closed porosity (about 30 %) and excellent compressive strength (maximum 105 MPa) have been obtained after firied at 1700 °C.

Keywords: Porous mullite ceramics; transient liquid phase diffusion; closed porosity; compressive strength.

1. Introduction

Owing to their excellent properties, such as low thermal conductivity and thermal expansion coefficient, high specific surface area and refractoriness, excellent mechanical properties and thermal shock resistance [1-3], the porous mullite ceramics are widely used as thermal insulators [4-5], membrane supports [6-7] and gas/liquid filters [8-9]. In the past few decades, several processing methods have been developed to fabricate porous ceramics, such as adding pore-form agent [5,10], direct foaming [4], foam gelcasting [3,14], gelation-freezing [11] and molten salt [12]. Atisivan et al. [13] prepared porous mullite ceramics with the porosity of 30-45 % and compressive strength of 20-50 MPa by a fused deposition process. Deng et al. [3] using the foam-gelcasting process to fabricate