MICROWAVE SINTERING OF MULLITE

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ABSTRACT

Microwave sintering possesses unique attributes and has the potential to be development as a new technique for controlling microstructure and to improve the properties of advanced ceramics. Because microwave radiation penetrates most ceramics, uniform volumetric heating is possible. Thermal gradients, which are produced during conventional sintering because of conductive and radioactive heat transfer to and within the part, can be minimized. By eliminating temperature gradients, it is possible to reduce internal stress, which contributes to cracking of parts during sintering, and to create a more uniform microstructure, which may lead to improved mechanical properties and reliability. The sintering of mullite has traditionally been carried out using either gas fired or electrically heated resistance furnaces, both of which primarily heat only the surface of the components, relying on thermal conduction to bring the bulk of the material to the sintering temperature. Microwave heating offers the advantage of being able to deliver heat more uniformly to the bulk of the component thereby substantially reducing the thermal gradients and allowing rapid sintering. The majority of the literature work deals with the sintering of mullite composites the simultaneous synthesis and sintering of mullite (composites or obtained form chemical precursors) [1-5], just a few deals with the sintering at 2,45GHz of high grades mullites (>99%). This work has as aim the microwave hybrid heating of high-grade mullite at 2,45GHz. The mullite – SCIMAREC MP40, average particle size of 1.48µm – powder were dispersed in an aqueous median by ball milling, for 4h, freeze dried and then cold isostatically pressed at 200 MPa into cylindrical samples of approximately 20 mm in diameter and 3 mm in thickness. The green samples were conventionally sintered with a heating rate of approximately 20^{o}C/mim and a soaking time of 120 mim. A 2.45 GHz microwave system, with silicon carbide as the susceptor agent, was used to the sintering of the samples. The heating cycle of the microwave sintering varied from 20 to 30 mim. The cooling cycle was not controlled, but all the sintering cycle do not extended more than 1h. The density was determined by the Archemedes method. The microstructural analyses were conducted using SEM. Based on the results can be observed that the conventionally and microwave sintered mullite have similar microstructures, but the densification of the microwave mullite was much faster then the conventionally one, reaching densities of 97.5% in just only 20 mim.

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