OPTIMIZATION OF THE PRODUCTION STEPS OF Al_2O_3-ZrO_2 NANO-COMPOSITES

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A developed method for preparation of dense, homogeneous microstructure with high mechanical properties of Al_2O_3-ZrO_2 nano-composite ceramics by advanced colloidal processing i.e. slip-casting was investigated. Rheology was the main tool used for evaluate and controlling of the homogeneity of high solids concentrated Al_2O_3-ZrO_2 suspensions. Stability of suspensions by measuring of the particle charge, known as the zeta potential is optimized by an advanced electroacoustic measurement which is called electrokinetic sonic amplitude 'ESA', and the body prepared is characterized with respect to microstructure and mechanical strength. The results obtained from optimization of the rheological properties gave good correlation between started powder characteristics, colloidal and rheological properties, shaping, sintering and microstructure of Al_2O_3-ZrO_2 nano-composites. Also, emphasis on the improvement and controlling of the grain growth in the range of nano-sized and design the compact desirable microstructures. The results from this developed method show a new way for on-line controlling the stability and quality of highly concentrated suspensions and preparation of dense and homogeneous microstructures.

Key words: *Al_2O_3-ZrO_2, rheology, electroacoustic, zeta-potential, slip-casting, microstructure, bending strength, SEM*

1. Introduction

The forming and sintering of nano-particle sized powders is often difficult because of the major factor that nanosized powders are often heavily agglomerated leading to poor packing, low green densities and heterogeneous pore structures. This factor often leads poor densification and poorly controlled grain growth. In the state of agglomeration, microstructure show significant abnormal grain growth. The improvement of properties is also greatly dependent on the elimination of heterogeneity in the green body that could create flaws, isolated pores, voids and residual stresses [1–5]. In the case of rheology, optimizing of the formulation of high solids concentrated Al_2O_3-ZrO_2 nano-composites suspensions requires a suitable method for measuring the particle charge, known as the zeta potential which is not possible to measure by standard devices use optical techniques and are therefore limited to colloids. One of the main aims of this present work was optimization of the stability of high concentrated Al_2O_3-ZrO_2 suspensions up to 77wt% by using ESA, which avoids dilutation of suspensions and in order to monitor and characterize the electrokinetic behaviors by measuring directly on the concentrated suspensions. Also, the second aim was optimization of sintering temperature, which could give the maximum bulk density near to theoretical density, minimizing of porosity, increasing mechanical properties.

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