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The role of kyanite in the crystallization and densification of the high strength mullite matrix composites

Microstructure and mechanical properties

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Abstract

The crystal structure, the unit cell parameters and the extent of mullitization were determined, using the Rietveld method, for range of mullite matrix formulations in which kyanite is used as particles reinforcement. The results combined with the mechanical properties and microstructure indicated the effectiveness of the kyanite particles to enhance the strength (>200 MPa), the Vickers hardness (>11 GPa) and the elastic modulus (150 GPa). The strengthening mechanism was particularly linked action of particles reinforcement. At low temperature, kyanite acts as fillers reducing the porosity and playing the role of nucleation sites for the crystallization of

metakaolin to mullite. At high temperature (>1350 °C), kyanite decomposes to mullite avoiding the grain growth of the existing crystals and delaying the densification. The extent of the reduction in porosity and the extreme limitation of the liquid phase ensure the homogeneity and the refractoriness that justify the strength enhancement. The unit cell parameters and the crystal structure confirmed predominance of the mullite 3:2 with their small grain size being one of the most stable mullite phases. The small size of their particles and the continuity into the mullite matrix composites allow good packing process for the optimum characteristics achieved: strength, microstructure and thermal expansion coefficient.

Keywords

Kyanite Mullite Microstructure Vickers hardness Elastic modulus Grain growth

Notes

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