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Improved fracture behavior and mechanical properties of alumina textured ceramics

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Abstract

[0001]-oriented alumina ceramics with texture fractions (F_{0001}) ranging from ~9.6% to 93.6% were prepared by templated grain growth (TGG) of nanoscale matrix. Ceramic density directly controls F_{0001} . Impingement of textured grains can be observed at $F_{0001} \geq 58.4\%$. When fracturing samples along [0001], the interfaces between basal surfaces of the impinged textured grains provide a favorable path for crack deflection, and the deflection distance becomes longer with increasing F_{0001} . As a result of both crack deflection and high density, optimum fracture toughness $\sim 4.6 \text{ MPa}\cdot\text{m}^{1/2}$ and flexural strength $\sim 589 \text{ MPa}$ were achieved at $F_{0001} = 93.6\%$, which are much higher than those obtained in the randomly oriented counterpart. This work can provide guidelines for the design and synthesis of novel structural ceramics with improved performance.

Keywords: Structural ceramics; Texture; Interfaces; Indentation; Mechanical properties

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