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## Role of Microstructural Features in Toughness Improvement of Zirconia Toughened Alumina

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### Abstract

Ceramics constitute an integral part of highly efficient armours due to their low density, high hardness, strength and stiffness. However, they lack toughness and multi-hit capability. Therefore, zirconia toughened alumina is investigated. The hardness is evaluated using Vickers, Knoop and instrumented indentations, while the fracture toughness is evaluated using the indentation technique and Charpy tests. The strength is evaluated using ring-on-ring, four point bend and drop weight tests. The Young's modulus is evaluated using the unloading instrumented indentation curves. Microstructure, porosity and density are characterised using ultrasonic scanning, Archimedes principle, optical and scanning electron microscopy. Results show an indentation size effect on all mechanical properties. A substantial improvement in toughness is achieved through retardation of crack initiation by tetragonal-to-mono-clinic phase transformation in zirconia particles, crack deviation thanks to appropriate grain structure, as well as energy absorption by densification due to remaining porosity. This improved toughness is expected to promote multi-hit capability.

### Keywords

Zirconia Toughened Alumina, Toughening Mechanisms, Fracture Toughness, Ballistic Performance, and Multi-Hit Capability

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