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Biomimetic Microstructural Design of a Ceramic-Ceramic Composite to Optimize Mechanical Properties

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Summary

Ceramic materials have long had the potential of being used in high performance engineering applications. Many years and funding have been spent in demonstrating that potential. However, ceramics are not being fully used in the engineering community due to high reject rates caused by internal flaws created during processing.

Metal processing and results, in particular, have been standardized so that when one is using SS316, for example, one knows the processing conditions, expected chemistry, grain morphology and performance characteristics. ASTM and NIST are attempting to standardize ceramic materials technology and materials and are making steady progress. Due to the advent of nanotechnology, microstructural chemical and morphological processes are becoming better understood, thus facilitating a more reliable prediction of performance characteristics of ceramics.

Extensive characterization of a hot pressed alumina/titanium diboride composite having a biomimetically designed microstructure was performed during past research. An understanding of the effects of the synthesis and processing technologies facilitated the control of a ceramic-ceramic microstructure that demonstrated a significant and reproducible improvement in high performance properties.

This paper will describe the recent progress made in the fundamental understanding of the processes involved on the nano and micro scales in the design and microstructural control of a multifunctional ceramic-ceramic composite. Results will include nano and micro scale effects of synthesis and forming on the resultant dense ceramic.

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