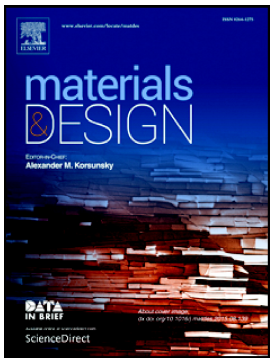

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Multilayer graphene reinforced functionally graded tungsten carbide nano-composites

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Abstract:

Mechanical and tribological properties of functionally graded multilayer graphene (MLG) reinforced WC-TiC-Al_2O_3 ceramics prepared employing two-step sintering (TSS) are determined in this paper. Results showed that MLG can act as not only an exceptional reinforcement phase, but also a superior lubricant phase. A 0.1wt% MLG /WC-TiC-Al_2O_3 ceramics exhibits ～53.3% enhancement in fracture toughness, ～73.8% decrement in friction coefficient, ～82.65% improvement in wear resistance in comparison with monolithic ceramics. MLG bending, wrapping, interface debonding, MLG wall and network, MLG induced weak interface, grains bridging by MLG, MLG pullout, crack deflection, crack bridging and crack stopping are the major toughening mechanisms. The dramatic improvement in tribological performance is attributed to the self-lubrication of MLG and easily formed friction layer in the contact interface. Furthermore, the unrivalled thermal conductivity of MLG and its rather significant effect in inhibiting the grain growth are the important contribution to the improved tribological performance. Therefore, the functionally graded MLG/WC-TiC-Al_2O_3 ceramics are conducive to be engineered as high-speed cutting tools.

Keywords: FGM; MLG; Microstructure; Mechanical properties; Tribological properties

1. Introduction

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