Fracture Behavior of the TaC-Graphite Stacked Ceramics using Percolation Modeling

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Abstract

Despite the wide application of the ceramics such as Tantalum oxide (TaC) , they are prone to sudden failure due to their brittle behavior. The coverage with a flexible graphene fiber shell for such ceramic cores improves their overall toughness. We explore the role of the composition and the arrangement of the core-shell structures in their fracture behavior. In particular, we analyze the formed cracks and correlate the tortuosity to the fracture energy, which is measured experimentally. The results are useful for quantitative understanding of the design parameters for improving the mechanical performance.

Key words: Fibre ceramics composites, Stacking, Mechanical Behavior, Fracture Energy.

1 Introduction

Ceramics are widely used in the industry as heat and corrosion resistant components [1, 2]. However the brittle behavior of these materials makes them prone to fracture and failure, particularly in environments of extreme states of temperature and loading [3, 4]. To circumvent their catastrophic failure while still retaining some of the desired mechanical properties, myriad options and fabrication techniques have been investigated [5]. Depending on the shape of the used composite [6, 7, 8, 9, 10], their configuration in the bulk [11, 12, 13, 14], and the type of inter-material or inter-laminar bonding [15, 16, 17, 18, 19], the behavior of fracture propagation could undergo crack penetration, deflection and delamination [20, 21, 22, 23], crack bridging [24, 25], and crack bifurcation [26, 27, 28]. The proper choice of material combinations and fabrication methods boosts

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