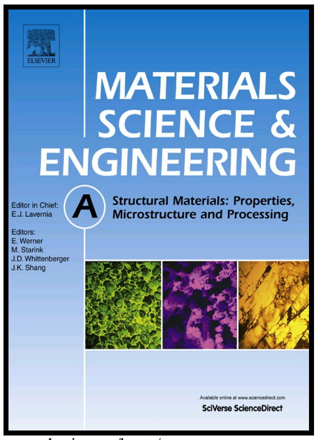

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# Fracture behaviour of cast in-situ TiAl matrix composite reinforced with carbide particles

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## Abstract

Three-point bending tests, Charpy impact tests and numerical simulations were carried out to study fracture behaviour of in-situ TiAl matrix composite reinforced with $Ti_2AlC$ particles prepared by centrifugal casting of Ti-44.5Al-8Nb-0.8Mo-0.1B-5.2C (at.%) alloy. The brittle fracture behaviour of the in-situ composite includes crack deviation, microcrack formation, carbide fragmentation, delamination on the matrix-carbide interfaces and pull-out of the carbide particles from the TiAl matrix. The crack initiation and propagation is related to applied load, deflection and acoustic emission events measured during three-point bending tests. A critical stress leading to a crack initiation in the notch region is numerically calculated for quasi-static loading conditions using finite element analysis (FEA). The measured fracture toughness values are comparable to those of some in-situ TiAl matrix composites prepared by casting and reactive processing.

***Keywords:*** intermetallics; composites; fracture toughness; finite element modelling

## 1. Introduction

Cast TiAl-based alloys are attractive for high-temperature structural applications [1–4]. However, inherent poor room-temperature ductility and insufficient strength at high temperatures (above 800 °C) limit their wide-scale applications. Intermetallic matrix composites may improve the deficiency of these lightweight alloys at high temperatures because of good combination of the properties of intermetallic matrix and reinforcement [5–11]. Recent studies have shown that in-situ TiAl matrix composites reinforced with homogenously distributed carbide particles can be prepared by melting followed by gravity or centrifugal casting of TiAl based alloys with various content of carbon [9-10]. Besides the primary carbide particles, the additional strengthening of TiAl matrix composites can be achieved by fine secondary needle-like $Ti_3AlC$ (P-phase) and plate-like hexagonal $Ti_2AlC$ (H-phase) precipitates similarly to that reported for several low carbon TiAl-based alloys [12-15]. The carbide particles improve fracture toughness of the in-situ TiAl matrix composites but alloying with carbon deteriorates their room-temperature tensile ductility [14-15]. The increase of the fracture resistance was attributed to crack trapping and crack bridging mechanisms [16]. In spite of the previous studies [7-11], only limited information is available about the effect of $Ti_2AlC$ particles on fracture behaviour of in-situ TiAl matrix composites prepared by centrifugal casting. The centrifugal casting represents widely applied technology