STRESS MEASUREMENT DURING CRACK PROPAGATION IN METAL MATRIX COMPOSITES USING MICRO-RAMAN SPECTROSCOPY

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Abstract
The measurement of stress in the SiC particles during crack propagation was investigated by micro raman spectroscopy. The experiment was carried out *in situ* in the Raman spectroscopy. Experimental results showed that cracks due to monotonic loading propagated by the debonding of the particle/matrix interface and particle fracture. A high decrease in stress was observed with the interfacial debonding at the interface and with the particle fracture on the particle. Moreover, the critical tensile stresses for particle-matrix interface debonding and particle fracture developed in hybrid MMC were also estimated during the crack propagation.

1. Introduction

Aluminium based metal matrix composites (Al-MMCs) remain an interesting field of materials for technological development and have generated a significant amount of interest due to their high strength, stiffness, low density and higher operating temperatures compared to conventional engineering materials [1, 2]. Addition of ceramic reinforcement, such as SiC particles and Al_2O_3 whiskers, to conventional aluminum alloys, increases the modulus and fracture resistance of the Al-MMCs [2, 3]. Therefore, Al-MMCs are considered an attractive materials for many structural applications such as aerospace and automotive industries and wear applications, especially in the frictional area of braking system [2].

Although Al-MMCs have many advantages, their use in structural applications is sometimes hindered as their damage tolerance properties are relatively poor. These composites are often behaves like brittle material, especially when higher volume fractions of reinforcement is added to them [4]. Many studies have demonstrated the fracture behavior and the damage mechanism of ceramic particulate reinforced Al-MMCs. These studies concluded that the large differences in strain carrying capability of elastically deforming reinforcement and plastically deforming matrix alloy determine the key mechanism of fracture of Al-MMCs [5-7]. Owing to the constrained plastic flow of the matrix between the reinforcement particles in the MMCs, hydrostatic stresses develop in the matrix which plays an important role in the failure mechanism during monotonic and cyclic deformations [8]. Different constraint levels on the matrix flow control the local failure process (e.g. particle fracture, interfacial debonding and dimple fracture of matrix alloy). Among these, interfacial bonding between reinforcing particles and matrix alloy tends to be a dominating factor in local failure processes and the strengthening of Al-MMCs. Good interfacial bonding yields high dislocation density in the matrix