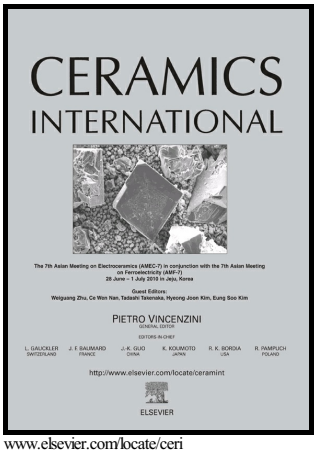

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Material deformation and removal mechanism of SiCp/Al composites in ultrasonic vibration assisted scratch test

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Abstract

The material removal process of SiCp/Al composites is a result of synergetic deformation and interaction among Al matrix, SiC particles and interface. The non-homogeneity of microscopic mechanical properties due to the inherent polyphase heterogeneity of SiCp/Al composites will directly affect the removal mechanism and surface integrity in the machining process. This paper aims to gain further insight of the material deformation and removal mechanism of SiCp/Al composites in ultrasonic vibration assisted machining process. The elastic modulus and hardness of SiCp/Al composites were determined through the indentation test by loading on Al matrix and SiC particles, respectively. Due to the interaction effects of the three phases during the deformation process, when the indenter is on a single phase, the influence of the other phases cannot be neglected and is reflected in the *P-h* curves. Scratch force, friction coefficient and material removal behavior were investigated in traditional scratch (TS) and ultrasonic vibration assisted scratch (US) tests. In most cases, with the assistance of ultrasonic vibration, scratch force and friction coefficient in US process are smaller than those in TS process, and the reduction of them is modeled and analyzed. The material removal behavior of SiCp/Al composites is similar to metal at the macroscale, and a high material removal rate is achieved in US process. SiC particles tend to maintain the structural integrity rather than be fractured or pulled out in US process. The scratched surface in TS process is damaged to a greater degree than that subjected to US process.

Keywords: Deformation and removal mechanism; SiCp/Al composites; Indentation; Ultrasonic vibration assisted scratch; Scratch force; Friction coefficient.

1. Introduction

Metal matrix composites (MMCs) are defined as relative ductile metal matrix