Advanced Materials Research Vols. 418-420 (2012) pp 2153-2157
Online available since 2011/Dec/06 at www.scientific.net
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doi:10.4028/www.scientific.net/AMR.418-420.2153

Abrasive jet polishing of micro groove using compound SiC abrasives with compound additives

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Keywords: Abrasive jet polishing, Surface roughness, Atomization

Abstract. This study examined the performance of abrasive jet polishing (AJP) on SKD61 mold surfaces using wax-coated SiC abrasives fabricated by gas atomization. Comparison of surface quality achieved reveals significant surface roughness reduction by wax-coated abrasives. The wax coating not only covers most of the sharp ends of the abrasive, thus making smooth the abrasive surface; it being elastic also provides a cushioning buffer. These two features contribute to ameliorate the direct impact of heavy peening, thus preventing surface hardening, superficial embedment or deep scratches. Moreover, compound additives including water wax and water were added to the wax-coated #3000 SiC abrasives at a mix proportion of 500: 1000: 1500 (water wax: wax-coated SiC: water) for polishing mold surfaces of different forms. Results show that the compound additives provide addition cushioning effect and facilitate the sliding and grinding of abrasives, resulting in fine polishing and good surface quality. The reflection property of micro-groove was much enhanced by AJP using wax-coated #3000 SiC abrasives with the compound additives.

Introduction

Abrasive jet machining (AJM) [1] is a non-traditional machining approach. It involves removal of the sacrificial layer and is often employed to machine holes in grid array of micro components. Previous research on AJM focused mainly on examining the quality of holes machined [2]. In recent years, AJM has been applied to polishing and there are studies on abrasive jet polishing (AJP) of SKD 61 mold steel [3]. Experimental investigation of Mau et al. [4] found that SiC abrasives with water wax as additive can efficiently remove scratches on free-form machined surfaces of SKD 61 mold steel. Not only is surface roughness reduced, the time required for polishing is also significantly shortened. Despite the good polishing effects achieved, using abrasives of the same material and diameter results in problems such as hardened surface due to heavy peening of abrasives and superficial embedment, both of which undermine the final surface quality [5].

In view of the above, this study proposed a novel wax-coated SiC abrasive. The elastic coating on the abrasive facilitates its sliding and grinding during processing. Current methods for manufacturing metal powders include gas atomization [6], water atomization [7] and ultrasonic gas atomization [8]. These methods can process metal powders of various shapes, sizes and diameters using different atomization and cooling processes. Among them, gas atomization involves a simple process and incurs low manufacturing cost. In this study, wax-coated SiC abrasives were fabricated by gas atomization and applied to AJP of SKD61 mold surface to examine its surface grinding performance. Moreover, compound additives of water wax and water were added to the wax-coated #3000 SiC abrasives at a mix proportion of 500: 1000: 1500 (water wax: wax-coated SiC: water) for polishing a micro-groove. Surface quality thus achieved was examined to shed light on the polishing performance of the abrasives on mold surfaces of different forms.

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