Optimization of process parameters for micro milling of Ti-6Al-4V alloy using Taguchi-based gray relational analysis

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Optimization of process parameters for micro milling of Ti-6Al-4V alloy using Taguchi-based gray relational analysis

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Abstract

In this study, the effects of the cutting parameters on the surface quality and burr width were investigated in the micro milling of Ti-6Al-4V alloy. Spindle speed, feed per tooth and depth of cut are selected as the control factors. Taguchi-based gray relational analysis was used in the optimization of the cutting parameters for minimal burr width (for up and down milling operations) and surface roughness (Ra). The contribution percentages of the control factors were determined by using analysis of variance (ANOVA). According to the obtained results, it was determined that the feed rate value for the best surface quality was 0.25 μm/tooth. At lower feed rate values, ploughing takes place and the surface quality deteriorates. On the other hand, it was found that it is more appropriate to use values a_p of 0.1 mm and n of 10000 rev/min to produce minimal Ra. The burr width on the down milling side is higher than that on the up milling side. A lower feed rate and greater depth of cut lead to an increase in burr width. In addition, higher spindle speeds increased the burr width due to rapid tool wear.

Keywords: Micro milling, Surface roughness, Burr formation, Gray relational analysis

1. Introduction

Micro machining is a machining process in which cutting tools with diameters of 1–1000 μm are generally used [1-3]. Nowadays, many methods are employed in the manufacturing of a micro equipment. It is possible to categorize these methods into three different groups as chemical, electrical