Effect of peak current and pulse peak voltage on machined surface morphology during WEDM of TiNiCu shape memory alloys

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1. Introduction

Previous experimental investigations reveal that wire electro discharge machining (WEDM) parameters pulse on time 110 µs, pulse off time 30 µs, 45 volts servo voltage and 6 m/min wire feed rate results in suitable material removal rate, surface roughness, kerf width and recast layer thickness [1-3]. Aforementioned WEDM parameters can be categorized as secondary electrical parameters whereas peak current and pulse peak voltage are primary electrical parameters which have higher degree of influence on nature of electrical discharge during WEDM process [4,5]. Current investigation is carried out to find out the effect of peak current and pulse peak voltage on machined surface morphology as this WEDM response determines surface roughness and hence quality of the machined product. Average surface roughness depends on several features of machined surface which are discussed in this study.

2. Body of abstract

TiNiCu shape memory alloys are well known for actuator as well as biomedical applications [6,7]. Wire EDM was found to be most suitable technique to machine shape memory alloys as damage caused due to this process is minimal compared to other non-conventional machining processes [8]. Microactuator and biomedical applications demand components having intricate profiles which are possible using WEDM technique. In this investigation peak current was varied in six levels whereas pulse peak voltage was varied in three levels as per machine capability. A simple factorial experimental plan was implemented to perform 18 experimental trials and corresponding machined surface morphology were studied using scanning electron micrographs. Figure 1 shows scanning electron micrographs of the machined surface for 18 factorial experimental trials. It was found that high peak current and pulse peak voltage lead to severe "splashed" morphology whereas lower values indicate more uniform sparking conditions. Furthermore, experiments were carried out to correlate machined surface morphology results using obtained spark profiles. It was found that an intense discharge condition has slight advantage over slightly less intense discharge conditions as higher surface roughness was observed for slightly lower peak current and peak voltage settings. The reason behind this slight spike in surface roughness was correlated with presence of debris and more melt free zones which results in increase in average surface depth value (Rz), which in turn leads to higher average surface roughness (Ra). Surface roughness generally increases with increasing peak current [9]. However, this paper presents the mechanism behind rise in average surface roughness (Ra) even at slightly lower peak current and peak voltage settings and identifies suitable range of peak current and peak voltage settings to obtain better machined surface.

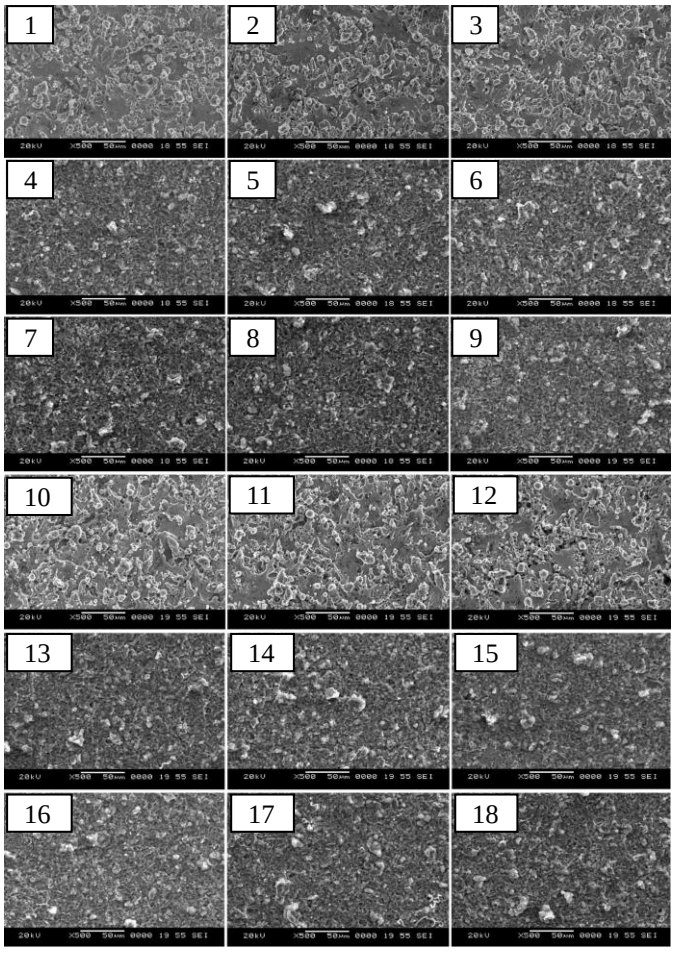

Fig. 1. Machined surface morphology

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