ABSTRACTS

INFLUENCE OF VARIANT ELECTROLYTE IN ELECTROCHEMICAL MICROMACHINING OF MICRO HOLES IN SMA USING TAGUCHI OPTIMIZATION

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Electrochemical micromachining (ECMM) is one of the commercially successful modern machining processes used in various manufacturing industries. Nitinol, a shape memory alloy (SMA) material used as micro and nano component in bio medical fields is difficult to machine using traditional methods due to its super elasticity and shape memory effect. This problem induced in studying the machining characteristics of NiTi alloy using ECMM process. In this work, an effort is taken to produce micro holes in SMA–NiTi alloy of 0.25 mm thickness using variant electrolytes such as the passivating electrolyte (PE) and the non-passivating electrolyte (NPE) to study the machining characteristics. The variable input parameters considered are voltage, duty cycle and feed rate to study their effect on performance characteristics such as MRR, overcut, circularity and conicity. This study resulted in finding the suitable and optimized parameters for machining Nitinol with PE and NPE with better precision and good surface integrity. Optimization studies are also carried out by Taguchi method using minitab statistical software.

Keywords: ECMM, Nitinol, passivating electrolyte, non passivating electrolyte, Taguchi optimization

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CONCLUSIONS

Electrochemical micromachining of Nitinol of 0.25 mm thickness is done by creating a micro hole for 500 μm using both passivating electrolyte and non-passivating electrolyte. From the experiments, the machinability of PE and NPE was studied and the optimal parameters were found by using Taguchi method. The effect of various input parameters like voltage, duty cycle and feed rate on MRR, circularity, overcut and conicity was carried out.

For Machining Nitinol,

(i) To get higher MRR, Non-passivating electrolytes can be used.

(ii) To improve geometrical features, passivating electrolyte can be used.

The optimized parameter for MRR and geometrical features is found out and shown in Table 6.

When NPE is used as electrolyte, duty cycle is the most significant parameter followed by voltage and feed rate for the output parameters such as MRR, overcut and conicity. While for circularity, feed rate is most significant parameter followed by voltage and duty cycle.

When PE is used as electrolyte, duty cycle is the most significant parameter followed by voltage and feed rate for the output parameter MRR. While for overcut, circularity and conicity, feed rate is most significant parameter followed by voltage and duty cycle.

Non passivating electrolyte are aggressive in machining Nitinol as they do not induce passive layer while passivating electrolyte induce the stable passive layer on the material which prevents the aggressive machining on the surface of the material.

The accuracy of the ECMM Process can be enhanced as a rule by varying the electrolyte and electrolytic composition. The parts machined using nitrate solutions are the best for accuracy and surface finish.

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