IMPACT OF THE PROCESS VARIABLES ON THE PHOTO CHEMICAL MACHINING ETCH DEPTH OF STAINLESS-STEEL MATERIAL

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ABSTRACT: Nowadays photo chemical machining is basically one among many arising advanced processes to deliver stress and burr free miniature geometries. The examination of photo chemical machining at different temperatures and times by utilizing photographic tool has been done. The cycle is beginning with a step, firstly by drawing a geometry by using a different industrial software for base material. Stainless Steel material was chosen for the experimentation because it has great electric as well as warm conductivity. The controlled entities were time and temperature. The time and temperature are selected by analyzing the behavior of etching of steel material. The target concerning this examination is with the aim to accomplish the depth of etching on Stainless Steel plate which has a thickness 0.5 mm. The effect of control and response parameters are varying with times and temperatures. Due to the fast rate of species etchant collision on the surface of stainless steel at high temperatures, a high temperature leads to a high etching depth.

Key words: Photo etching, photo drawing, machining, PCM, High etching depth.

INTRODUCTION

The arising non-conventional processes, PCM discovers a wide variety of applications in the making of various micro level mechanical parts. PCM is otherwise called milling, photochemical machining, wet drawing, photograph scratching, photo chemical processing and so forth. There are mainly two kinds of polymers for the photo resist utilized in PCM.

- Positive photoresist.
- Negative photoresist

Within the positive photoresist part, the part that is dark in the photo- tool remains hard whereas the other part becomes softer and that non harden part is taken out, and in the negative photoresist part, which is inverse to the positive photoresist, the dark part in this photo -tool is taken away whereas the left over part of the photo - tool turns hard (Allen et al, 2004). The procedure begins with a stage in which a necessary design known as the photo-tool is created in a programme called AutoCAD and then printed on a transparent plastic sheet for etching (Cakir, 2006). Following that, a stage is completed by coating the metal surfaces with photoresist. After that, the design is secured to the photoresist, and it is exposed to strong ultraviolet radiation. Following being deposited to the photoresist, the design will be seen after development (Davis and Overturf, 1986). The process of manufacturing produces features as the metal part is dissolved away in the process of etching. Cutting tool is not needed for manufacturing of components, and thus due to this, other defects and stresses arise through metal cutting existing in the last portion of PCM (Kamble et al, 2019). The hardness of the material and the surface topology are the key points on which the etchant selection for machining of the parts depends upon. The etched part’s surface finishing, varies with different etchants (Kundra et al, 2019). Using cupric chloride and ferric chloride as etchants, researchers examined the impact of etching duration and etchant temperature on the surface quality and rate of etching on PCM of copper, aluminium, and Inconel 718. (Misal et al, 2017). Cupric chloride is the most suitable etchant for copper and its alloy and thus it
particles on the surface is much less which brings about least etch depth of engraving. Likewise, at most extreme times, the collaboration of etchant species on the surface is at a high point and because of this high depth of engraving is formed. Fig. 3 analyzed etching depth for various temperatures along with time. At most elevated temperatures the response between the etchant species on the surface develops quickly contrasted with another temperature.

**Comparison of surface roughness and etching temperatures**

The value of roughness is greatest at temperature of 49°C i.e., 0.377 µm because of a higher impact of etchant atoms on the outside part of the Stainless Steel. At this temperature, the species of etchant usually foster a lot more receptive particles compared with the others. Less value of the temperature implies a low responsive species crash upon Stainless Steel surface that brings about less roughness value. The energy of receptive species does increases with temperatures. Etching time additionally does have a huge impact on the roughness of the surface, at least time, the association of particles on the surface is much less which brings about least roughness of steel surface. Likewise, at most extreme times, the collaboration of species of etchant on the surface is at a high point because of which roughness of the steel is formed. Fig. 4 analyzed etching depth for various time and temperatures. At most elevated temperatures the response between etchant species on the surface develops quickly contrasted with another temperature.

**CONCLUSION**

This study analyzes the etching depth for various time as well as temperatures. This study thus creates conclusions that are listed as follows:

It has been investigated how process variables like etching time and temperature affect the depth of etching. Additionally, it should be remembered that temperature does have a significant role on etching depth. Due to the fast rate of species etchant collision on the surface of stainless steel at high temperatures, a high temperature leads to a high etching depth. Etchant molecules are also less numerous and have lower reactivity at low temperatures, which results in a shallower etch. By increasing the temperature as well as the etching time the etching depth keeps increasing. A deeper etching depth of 219 microns was attained in 120 minutes at a temperature of 49°C. The lowest depth is attained in 10 minutes at a temperature of 40°C, or 90 microns. The greatest surface roughness is attained in 120 min at 49°C, or 0.377 microns. The lowest roughness is attained in 30 minutes at a temperature of 40°C, or 0.150 microns.

**REFERENCES**


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