

Chapter 6

Experimental Investigation on ECMM With Nimonic 75 Alloy for Prosthetic Component

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ABSTRACT

Electrochemical micromachining is an advanced technology of recent trends of machining of hard and electrically conductive materials in micrometer and sub-micrometer scale. This manufacturing technique finds application in many technologically demanding industries: locomotive, biomedical, electronics, etc. However, due to very small inter-electrode gap, there is some limitation in using this machining process. This chapter aims at developing an optimized model for flow analysis of electrolyte in inter-electrode gap to obtain optimal process parameter for machining. Experimentation has been done to associate the findings of optimized output in ECMM such as material removal rate (MRR), overcut, and depth. Influence of voltage, feed rate, concentration, pulse on/pulse off ratio, and IEG investigated and finally optimized using response surface method. The effect of the process parameters are also analyzed using ANOVA.

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INTRODUCTION

Historical Background of Electrochemical Machining

Currently Biomedical instruments are more micro in size and high accuracy. Manufacturing and selecting suitable machining process of such instruments are a challenge for present researchers. Electrochemical process is one of the advanced machining processes and can be possible to manufacture micro sized medical instruments like micro passages for surgical equipment, nozzles and tubes for dentist equipment, etc.

It is a machining process of metal removal generally used in mass production based on electrochemical process. Usually the ECM process machines hard materials, otherwise challenging to machine by conventional method. This method of machining is known as the reverse of anodizing or electroplating as a basic principle. In ECM process, the work piece is machined by controlling anodic dissolution at its atomic level. In which the desired shape of tool as high current at low potential variance through an electrolyte is imprinted on the work piece. The electrolyte is generally water based neutral salt solution. Because of its ability to machine hard materials at greater accuracy, ECM is considered as one of the advanced machining technology and is used in the fields of aerospace, defense, aeronautics, medical equipment. Recently ECM is also finding its application in the field of automobile & turbomachinery because of its inherent advantages low tool wear, lower thermal mechanical stress on work piece and more precision machining in difficult to cut materials by other non-traditional machining processes.

Why Electrochemical Micromachining (ECMM)

As the world is moving towards miniaturized, competent and superiority products, micromachining technique will play a very vital role in realizing the potential the miniaturization era where all products are getting smaller with better efficiency. Micromachining plays a crucial role in technologically demanding industries like medical, electronics, computer, and aerospace industry where complex shapes, holes, slots of micro dimension need to be made on a work piece with high accuracy. Material removal of the dimension ranging between 1.0 micrometers to 999.0 micrometers comes under micromachining. Using conventional micromachining for producing these

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