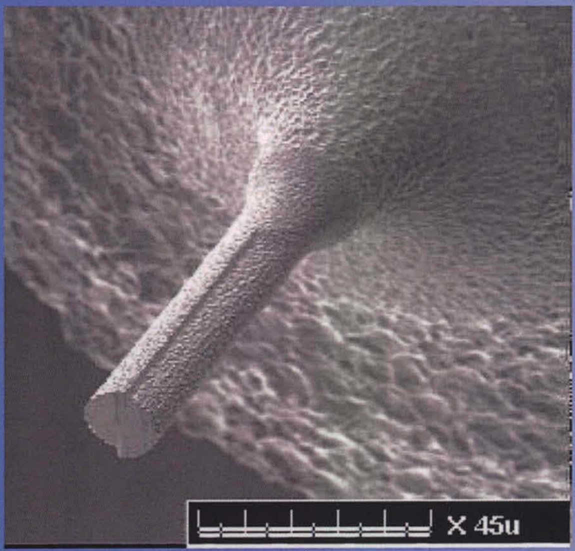
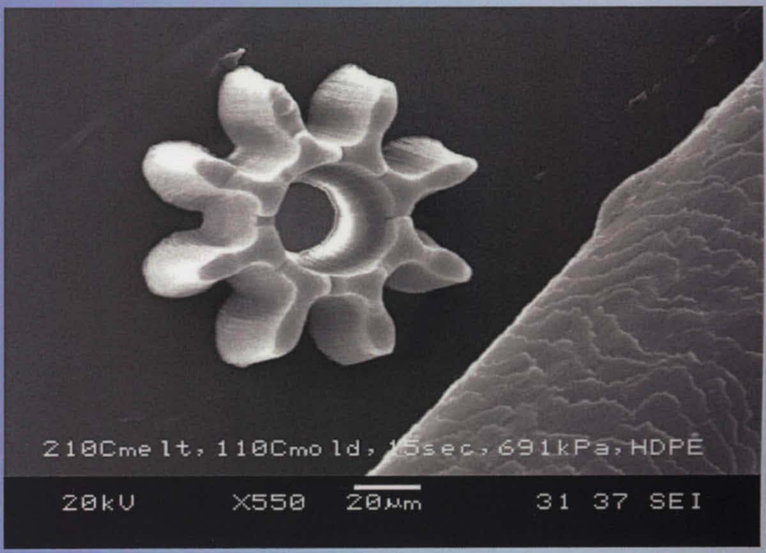
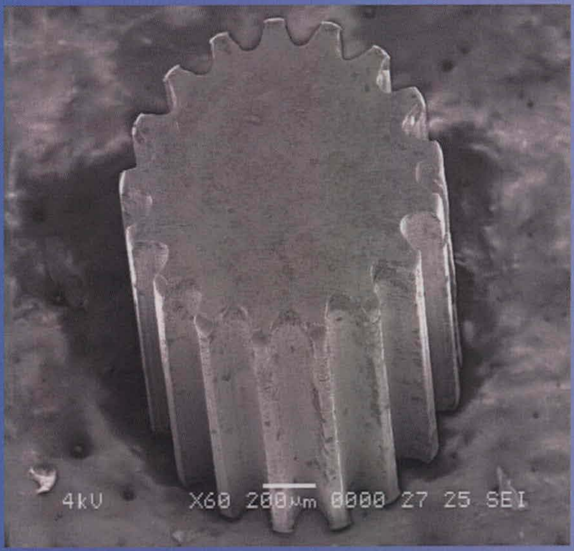
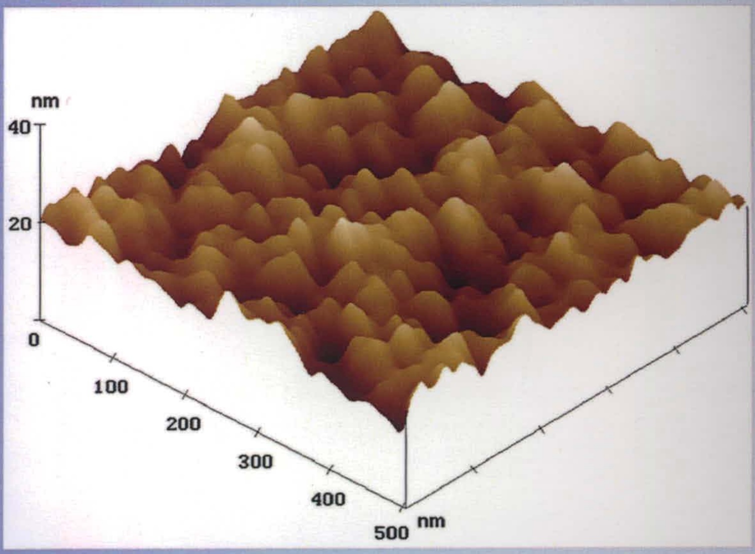
Advanced Machining Process









Editors
Mohammad Yeakub Ali
AKM Nurul Amin
Erry Yulian Triblas Adesta

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AKM Nurul Amin
Erry Yulian Triblas Adesta

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Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

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Chapter 13

An Introduction to Electrical Discharge Machining

Ahsan Ali Khan✉ and Mohammed Baba Ndaliman
Faculty of Engineering – International Islamic University Malaysia
✉ : mbndaliman@yahoo.com

Keywords: Electrical discharge machining (EDM), Electrode, Dielectric Fluid, dry EDM, Wire-cut EDM, Micro-EDM.

Abstract. The fundamental features of electrical discharge machining (EDM) were discussed in this chapter. The machining principle and its outcomes were highlighted in this chapter. The input variable of EDM presented here are electrical and non-electrical ones. The output of EDM process are given in terms of the material removal rate (MRR), tool wear rate (TWR) and the surface integrity. This chapter is concluded with a discussion on types of EDM. The various types presented here include: the die sinking type, the wire-cut, micro and the dry EDM.

Introduction

Electrical discharge machining (EDM) is one of the non traditional machining processes used to machined hard materials that were hitherto difficult-to-machine. It is a thermal process that involves melting and vaporisation of the pair of workpiece and electrode. The erosive effect of electrical discharge machining was invented by Joseph Priestly, a 1770 English scientist. The Lazarenkos in 1943 were credited to being the first duo to work on what becomes EDM today [1]. Since then, a refined and controlled machining process becomes established through removal of the destructive effects associated with electrical discharges.

The EDM Process

The EDM process uses electrical discharges to remove material from the workpiece, with each spark producing a temperature of between 10,000-20,000°C. A typical electrical discharge machine is shown in Fig. 1. The basic principle is the conversion of electrical energy into thermal energy through a series of discrete electrical discharges occurring between the electrode (tool) and workpiece immersed in a dielectric fluid. The insulating effect of the dielectric used in EDM process is very important as it prevents the electrolysis of the electrodes during the process. Spark is initiated when high voltage is applied between the electrode and workpiece at small gap as shown in Figs. 2a and b. Materials start to melt and get eroded from both the tool and workpiece surfaces. After each discharge, the capacitor is recharged from DC source through a resistor, and the spark that follows get transferred to the next narrowest gap. At the end, sparks spread over the entire workpiece surface leading to its erosion, or machining to a shape that is mirror image of the electrode. As a consequent to this high temperature operation, the workpiece is subjected to a heat affected zone (HAZ) the top layer of which comprises recast material (Fig. 3). The thickness, composition and condition of this layer depend on the discharge energy, the workpiece material, tool electrode and dielectric fluid. Both hard and soft surface layers can be produced despite perceived thinking that the recast layer is always hard. With ferrous workpiece materials, the recast layer