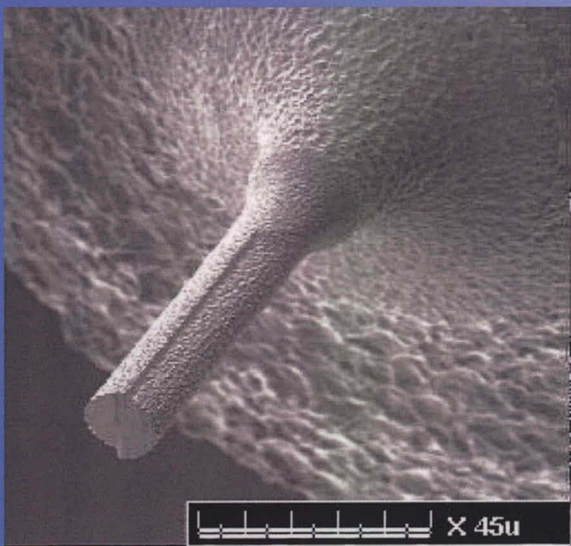
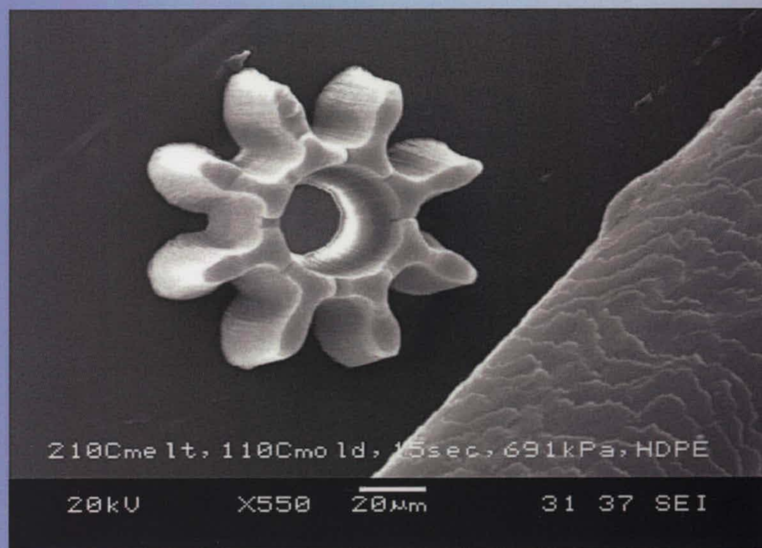
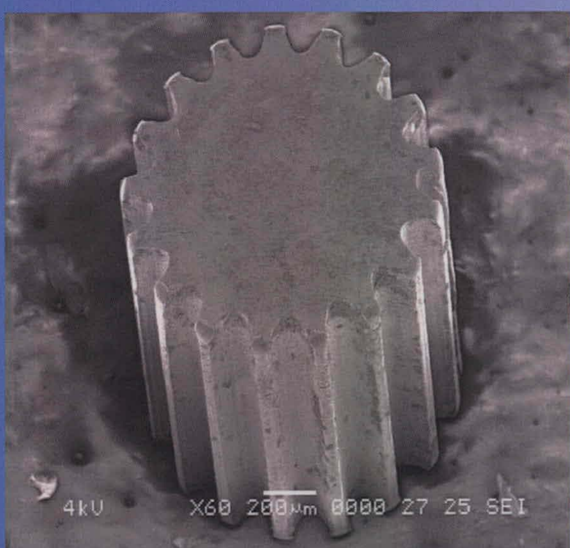
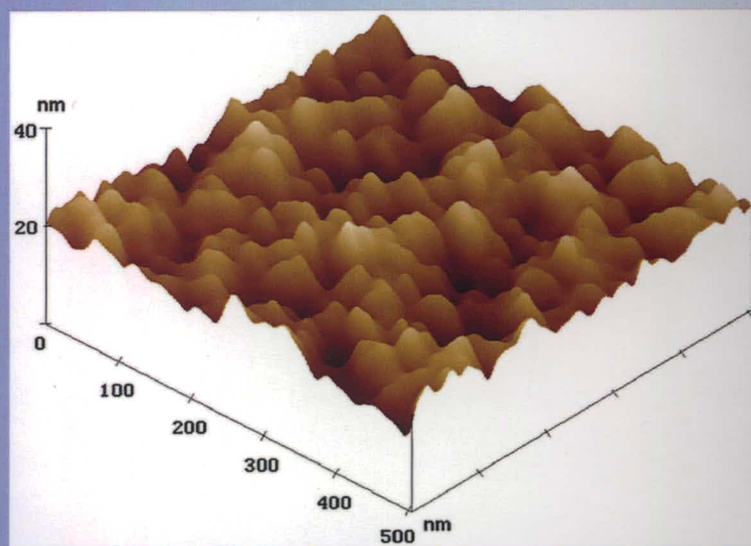
Advanced Machining Process









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Chapter 23

Micro Wire Electrical Discharge Machining of Tungsten Carbide: Analysis of Surface Roughness

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Abstract. This chapter presents a experimental study to develop mathematical model for machined surface roughness that relate the machining parameters. The basic objective is to achieve lowest possible surface roughness. A micro wire electro discharge machine is used on tungsten carbide workpiece. The electrode material was also tungsten. Taguchi method is used to formulate the experimental layout, to analyze the effect of each parameter on the machining characteristics, and to predict the optimal level of parameter values using Design Expert Version 6.0.8. It is found that these parameters have a significant influence on surface roughness. Mathematical model has been developed and the model is found to be adequate.

Measurements of Surface Roughness

The surface produced by EDM process consists of a large number of craters that are formed from the discharge energy. The quality of surface mainly depends upon the energy per spark. The roughness of the machined surface increases as the energy of the pulse increases. In other words, at higher pulse energy, the surface will be rough. The pulse energy is a function of the capacitance and the working voltage of the circuit. Therefore, by varying these two parameters fine (smoother) surface could be obtained. The surface produced by this process consists of micro-craters. Low energy discharges that leave small craters are necessary for fine surface finish. However, MRR is the low in order to get a low surface roughness.

The EDM surface is made up of three distinctive layers consisting of white layer/recast layers, heat effected zone and unaffected parent metal. EDM surface is dependent on the solidification behaviour of molten metal after the discharge cessation and subsequent phase transformation. The thickness of the recast layer formed on the workpiece surface and the level of thermal damage suffered by the electrode can be determined by analyzing the growth of the plasma channel during sparking. In addition, the EDM surface has a relatively high micro hardness, which can be explained by the emigration of carbon from the oil dielectrics to the workpiece surface forming iron carbides in the white layer. There are several numbers of useful techniques for measuring surface roughness:

Fast and repeatable, the NT1100 utilizes white light interferometer for high resolution 3D surface measurements, from sub – nanometre roughness to millimetre- high steps. On super smooth or rough surfaces, the versatile NT1100 provides repeatable surface measurement for R&D, wear and failure analysis, and process control. Figure 1 shows the WYKO NT1100 machine. The result for the surface roughness obtained by the machine and after taking the