Microelectrical discharge machining of Ti-6Al-4V: implementation of innovative machining strategies

4

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4.1 Introduction

In last 15 years, the demand for microproducts and miniaturized components has increased rapidly in various microengineering applications in automotive, avionics, biotechnology, communications, optics, and electronics industries. To fulfill these demands and ultimately meet the requirements of product miniaturization, micromachining processes—both conventional and nonconventional—are efficiently and effectively utilized. These processes also play a vital role in micromanufacturing and microfabricating miniaturized products and microsystems (Venkatesh & Izman, 2007, Yu, Rajurkar, & Shen, 2002). Among various micromachining technologies, microelectro discharge machining (micro-EDM) is one of the important and cost-effective thermoelectric type micromachining method capable of machining electrically conductive materials regardless of their hardness and strength. During the machining process, there is no direct contact between the tool electrode and the workpiece; therefore, machining errors due to deformation of the tool electrode as well as chatters, vibration-related inaccuracies, and mechanical stresses are absent (Ho & Newman, 2003).

In the Union Soviet Socialist Republics (USSR) in the 1940s, material removal (erosion) by a series of spark discharges in a controlled manner was first reported by two scientists, Doctors B.R. and N.I. Lazarenko, for stock removal from the workpiece (Ho & Newman, 2003). They invented a simple servo controller and successfully maintained the inter-electrode gap (IEG) between the tool and the workpiece. They also investigated the destructive effects of discharges and the mechanism of material removal to machine the desired shape by properly controlling the repetitive discharges. A number of research investigations were then carried out by many scientists for more enhancements related to discharge phenomena, spark gap control, and feed mechanism, as well as for better control of the erosion technique by employing computer numerical control, adaptive control mechanism, improved machine intelligence, and better flushing conditions. In 1968, Kurafuji and Masuzawa demonstrated the micro-EDM process and achieved a miniature

Microfabrication and Precision Engineering. DOI: http://dx.doi.org/10.1016/B978-0-85709-485-8.00004-8