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Surface modification of biomaterial embedded with pits using die sinker machine

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Abstract. Surface modification has been applied in many ways to enhance exclusive implant product. Electrical Discharge Machine Die Sinker (EDM DS) is a new approach to machine a macro surface on the biomaterial. In this study, investigations of current properties of EDM DS to obtain a new surface in titanium alloy (Ti-6Al-4V) and stainless steel (E-316-L), which placed pit on the material-sized (25 mm) diameter sample with a radius of 6.3 mm, were conducted. All the samples of concave textured circular pits with a fixed diameter and depth of 0.5 mm were successfully machined. This study revealed that the pits were produced in the concave cup and the lubricant was confined inside the pits, making easier contact between metal ball and metal concave surface. The results also show that the discharge machine is an attractive machining method for surface modification of biomaterial. This paper suggests that concave implant surface embedded with pits will work as a trap for lubricant and wear debris; in addition, it is possible to increase the lifespan of implant structure.

1. Introduction

Nowadays, there are many effective uses of biomaterial for equipment and devices in medical prosthesis. Biomaterial is currently the most successful and reliable orthopedic operation and has been reported to improve the patient's damaged health, especially for severe hip damage [1,2]. Biomaterial designed for implant must have osteoblast activity, osseointegration, proliferation and may reduce the adhesion [2-5]. Spark plasma sintering is one method that improved the properties of implant material [6-10]. Hence, in order to increase the level of resistance and longevity of the biomaterial (prosthetic), high-powered machine, such as Computer Numerical Control Electrical Discharge Machine Die Sinker (CNC EDM DS), is needed to machine pits on the biomaterial surface, as shown Figure 1. Discharge machine or spark erosion disintegration using pulsed electrical discharge is known as a non-conventional machining procedure to evacuate, to a great degree, hard and fragile materials which cannot be machined with ordinary procedures.

EDM, appropriate for highly accurate and very sophisticated metal shaping, was inferred by Behrens and Ginzel [11]. Other researchers claimed that EDM's current setting may influence the material surface and cause different roughness of surfaces [12]. On micro EDM, many researchers describe the characteristics,

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