Improving EDM Process on AZ31 Magnesium Alloy towards Sustainable Biodegradable Implant Manufacturing

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Abstract

The electrical discharge machining (EDM) process is an excellent method to machine with the high geometrical accuracy required for bio-medical implants. In implant fabrication, a higher surface roughness has led to a huge contact surface area which causes a higher corrosion rate. Uneven spark distribution in conventional EDM (C-EDM) has led to negative effects on the machined surface quality. Particles mixed-EDM (PM-EDM) was found promising to improve the quality of the machined surface. The objective of this paper is to improve the machined surface quality of AZ31 magnesium alloy using the PM-EDM method towards sustainability manufacturing of biodegradable implant. It was hypothesized that with the addition of zinc particles in the dielectric fluid, the roughness of the machining surface could be reduced. The Taguchi method was used with nine experiments on C-EDM and PM-EDM with an opened-loop system which were conducted with the same setting parameters. Different concentrations of the zinc particles were mixed in the dielectric fluid during the PM-EDM experiments. In both the C-EDM and PM-EDM experiments, the pulse on-time was found as the most significant parameter affecting the quality of the machined surface. However, the addition of the zinc particles in the PM-EDM experiments did end up with a positive effect on the machined surface quality. The optimized surface roughness obtained from the PM-EDM experiment had been reduced by 44% compared to C-EDM. The PM-EDM method has been proven to reduce the roughness of the machined surface. More research is required to determine the efficacy of the PM-EDM method in solving the high corrosion rate of the magnesium alloy. © 2016

Keywords: Biodegradable material; EDM; magnesium alloy; surface roughness; zinc particles

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