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PII: S0264-1275(15)30445-7
DOI: doi: 10.1016/j.matdes.2015.09.036
Reference: JMADE 606

To appear in:

Received date: 21 July 2015
Revised date: 7 September 2015
Accepted date: 8 September 2015

Please cite this article as: Priyaranjan Sharma, D. Chakradhar, S. Narendranath, Evaluation of WEDM performance characteristics of Inconel 706 for turbine disk application, (2015), doi: 10.1016/j.matdes.2015.09.036

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Abstract

Inconel 706 is a newly developed superalloy, which offers high mechanical strength along with easy fabricability thus making it suitable for turbine disk applications. Although Inconel 706 exhibits a substantial increase in stress rupture and tensile yield strength compared to other superalloys, its conventional machining yields poor surface finish and low dimensional accuracy of the machined components. Hence, wire electrical discharge machining (WEDM) of Inconel 706 has been performed and various performance attributes such as material removal rate (MRR), surface roughness (SR), recast surface, topography, microhardness, microstructural and metallurgical changes of the machined components have been evaluated. The experimental results revealed that servo voltage, pulse on time, and pulse off time greatly influence the MRR and SR. Due to high toughness of Inconel 706, no micro cracks were observed on the machined surface. Micro voids and micro globules are significantly reduced at low pulse on time and high servo voltage. But, there is a propensity of thick recast layer formation at high pulse on time and low servo voltage. EDAX analysis of recast surface exposed the existence of Cu and Zn which have migrated from brass wire. The subsurface microhardness was changed to 80 µm due to significant thermal degradation.

Keywords: Inconel 706; WEDM; topography; Microstructure; Microhardness; EDAX.

1. Introduction

In the recent times, machining of nickel-iron-based superalloys has become an active area of research due to its growing demand in aircraft turbines, rocket engines, power generation turbines, nuclear plants, chemical treatment plants and other challenging environments. These superalloys exhibit outstanding properties such as high toughness and ductility, good surface stability, creep resistance at high temperature, corrosion and oxidation resistance [1]. Therefore, their usage has vital importance in designing of high performance gas turbine engines [2]. Due to the requirement of high temperature and compressor ratio for advance gas turbine engines, it became necessary to utilize a newly developed superalloy [3]. Inconel 706 is one of the advance superalloy and specially developed for aircraft applications, particularly in manufacturing for turbine disks, diffuser cases, compressor disks, engine mounts, and fasteners. Since this alloy is not much prone to segregation, it could be used to fabricate enormous components and make it ideal for the manufacturing of gas turbine components. Conventional machining of nickel-iron-based superalloys include several issues, such as poor surface quality, low dimensional accuracy, high tool wear rate, and poor machinability [4].