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PII: S0263-2241(17)30168-9
DOI: http://dx.doi.org/10.1016/j.measurement.2017.03.009
Reference: MEASUR 4646

To appear in: *Measurement*

Received Date: 29 November 2016
Revised Date: 3 March 2017
Accepted Date: 4 March 2017

Please cite this article as: K. Mouralova, J. Kovar, L. Klakurkova, T. Prokes, M. Horynova, Comparison of morphology and topography of surfaces of WEDM machined structural materials, *Measurement* (2017), doi: http://dx.doi.org/10.1016/j.measurement.2017.03.009

# Comparison of morphology and topography of surfaces of WEDM machined structural materials

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Abstract
Wire Electric Discharge Machining (WEDM) is an unconventional machining technology using physical principles to cut materials. There are many factors affecting this process and having a fundamental influence on the final quality of the machined surface. Apart from the dielectric and wire electrode type used, these include, in particular, the machine setting parameters such as discharge current, gap voltage, pulse on and off time, and wire feed. Another very significant aspect of the machining process is mechanical and physical characteristics of the machined material including its heat treatment. This study deals with an analysis of morphology and topology of the surfaces of samples made of 4 structural materials and their 5 types of heat treatment. The analysis was carried out using electron microscopy (SEM) and a contact-less 3D profilometer which allowed evaluating the profile and surface parameters of surface quality including creating a 3D surface image.

Keywords: WEDM, electrical discharge machining, titanium alloy Ti-6Al-4V, AlZn6Mg2Cu, steel X210Cr12, steel16MnCr5

## 1. Introduction

Electrical Discharge Machining (EDM) is the machining process during which material is eroded by series of controlled sparks between electrode and the workpiece. Workpiece and the electrode, connected to pulse DC power supply, are immersed in the dielectric fluid, which is an electrical insulator until the ionization point. Than the fluid becomes an electrical conductor and the electric discharge occurs at the smallest gap between the workpiece and the electrode with the frequency of thousands of sparks per second. For each spark, with duration of about $10^{-4}$ to $10^{-6}$ s, ionization and deionization of the dielectric fluid occurs. The area around the spark is heated to 10 000 – 20 000 °C and the dielectric fluid around this area is vaporized, leading to increase in the pressure. Also small amount of workpiece and electrode material melts and vaporizes, which creates small craters on the surface. When the spark is turned off and time off period starts, drop of pressure leads to condensation of minute metal globules, which are carried away by flowing dielectric fluid. A layer of melted and resolidified material called recast can be found on the surface after EDM [1, 2, 3, 6, 7, 8].

For wire-EDM (WEDM), continuous wire is used as electrode and deionized water as dielectric (Fig. 1). Wire passes through the workpiece during machining and precise gap, known as sparking gap, must be maintained between them. Width of the final kerf is given